FIRE SAFETY DURING THE CONSTRUCTION OF LARGE/TALL TIMBER FRAMED BUILDINGS

HEALTH WARNING

There is a Chief Fire Officers Association (CFOA) Working Group presently sitting which will be producing new guidelines with the approval of the HSE and other parties with various building and construction interests. When this is published, APS will inform readers with an update.

INTRODUCTION

This Practice Note provides an update for the original PN 2/10 published in April 2010. The update is needed to cover a range of relevant activities in 2010 and early 2011 including the publication of revised HSE Guidance to Fire Safety Management on Construction Sites [HSG 168].

It should be understood at the outset that timber-framed buildings have been around as long as people have been building houses and although concerns have arisen following a number of serious fires which have taken place during the erection of timber framed blocks of flats, there is no suggestion that completed timber framed buildings are inherently unsafe or pose a specific fire risk. Timber framed construction offers many advantages (see box) but, subject to the quality of workmanship, it’s only during their construction that special precautions need to be taken.

In the past 10 years fires in large timber-framed buildings have occurred in Blackpool, Colindale, Edinburgh, London, Newcastle and the West Midlands, Glasgow and St Albans (to list the most prominent). The most recent and perhaps most serious of these was in Peckham, SW London. In all of these incidents, the project’s external structure was completely destroyed. In the case of the Colindale fire, in July 2006, a six storey, timber-framed block reportedly collapsed in 15 minutes. The Peckham fire, on 26 November 2009, not only destroyed the block under construction but also spread to other buildings and resulted in the evacuation of more than 300 people and serious damage to two blocks of maisonettes and a pub.

THE NATURE OF THE PROBLEM

Even before the Peckham fire, concern had been expressed by a range of authorities including the Fire Protection Association (FPA) which undertook a review of the Colindale fire in which it concluded that fires in large timber-framed structures during construction could result in serious impact. More specifically, the FPA identified the following potential problems:

- Escape problems for site staff due to distances involved and very rapid spread of fire
- Proposed occupancy of blocks in a project before completion of the rest of the project
- Lack of fire fighting shafts in a structure which would have had a height in excess of 18m
- Issues regarding the suitability of timber in principle and detailed questions regarding the treatment of the timber used and the design of the joists.
- The volume of timber used in the buildings created a hazard for both the construction workers and firefighters

1. However anecdotal experience suggests that inappropriate modifications undertaken in completed buildings can very easily adversely affect the fire safety factors of a timber framed structure and in the case of a block of flats modifications to one flat could create a hazard for others.
3. Under Scottish Building Standards, such a block would also have required a full sprinkler system
THE NATURE OF THE PROBLEM continued

• Timber-framed buildings are likely to be at their most hazardous during the early stages of construction where there is no active protection and probably very little passive fire protection
• Rapid fire spread, large amounts of heat and early structural collapse are all probable consequences of such fires
• Poor workmanship can contribute to rapid fire spread even in completed buildings

In the longer term, there are concerns that wear and tear, poor maintenance and alterations (both professional and ‘DIY’) will increase the risk of fire spread even in those structures where the original construction is good
• Partial occupancy could be a major life risk
• The use of timber-framed buildings for social housing will negate the conventional approaches to fire safety in dwellings such as early detection and ‘defend in place’ compartmentation.

GOVERNMENT RESPONSES

The Joint Ministerial Submission proposed a range of measures including the need for better project management, more detailed risk assessment, liaison with the fire and rescue service, better scrutiny of large5 timber-framed projects and more research into the wider risks of such fires. Additional training for the fire and rescue service should also be provided both in respect of recognizing the risks implicit in such structures and also in firefighting operations in such buildings under construction.

In July 2009, the Department for Communities and Local Government (GLG) issued a circular6 on fires in timber-framed buildings under construction which assessed the problems as follows:

“At incidents involving timber framed buildings, particularly during the construction phase, fire spread is likely to be extremely rapid and the unprotected structure liable to early collapse. High levels of radiated heat are also likely, constituting a hazard to firefighting personnel with the possibility of offsite fire spread to adjacent structures. Evidence relating to a number of fires in large timber framed buildings under construction indicates that once the fire is established, firefighting tactics are likely to be in the defensive mode.”

The Circular suggests that Fire Authorities (the legal entities which employ the fire and rescue service) should use their powers under Section 7(2)d of the Fire and Rescue Services Act 2004 to visit such construction sites to obtain information for ‘operational planning’. Fire and Rescue services are also encouraged to collaborate with Building Control departments and the HSE in respect of information gathering about potentially hazardous projects and in respect of enforcement activity ‘using both the Regulatory Reform (Fire Safety) Order 2005, (FSO)7 and the Construction (Design and Management) Regulations 2007, (CDM)’.

More detailed work has been undertaken by the London Assembly who published a report ‘Fire Safety in London: Fire in London’s Tall and Timber Framed Buildings’9 in December 2010

5 To be defined as any timber framed building of four storeys or above, or with an area of 2500m² or of a contract value of more than £2.5 million
7 This means that all fire fighting will be done externally and that efforts will normally be directed to preventing the fire from spreading to other structures,
9 http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/housing-planning/fire-safety-in-london

BENEFITS OF TIMBER FRAMED BUILDINGS

• Timber is a sustainable and renewable resource
• It is more quickly erected and can be largely prefabricated off-site allowing more consistent quality levels
• It offers a much lighter building footprint imposing less pressure on the ground and subsurface lending itself to use in brownfield sites which might have problems of soil contamination
• It allows more flexible approaches to construction using modular sections which can be assembled in different ways without the need for redesigning or re-engineering structures.

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MANAGING FIRE SAFETY IN TIMBER-FRAMED BUILDING PROJECTS

The principles of fire safety management are the same for timber-framed buildings as they are for those using more conventional construction materials. What differs is the need for the planning process to consider the following:

- The fire risk assessment informed by the higher probability of easy ignition and increased fuel load
- The need for special considerations for the safety of operatives and more specifically the means for giving warning of fire and means of escape in case of fire
- An awareness of the high risk at earlier stages of construction that in sites using more conventional materials.

HSG 168 was revised and updated and republished in 2010 and among the revisions is a new section on the hazards presented by timber framing as a method of construction. It must be remembered that the concerns of the HSE principally revolve around the risk to life of the site operatives or those who may be harmed by their activities so property protection issues may not be fully included in their guidance. The final document recommends:

**TIMBER FRAME BUILDINGS**

293 Timber is an accepted form of construction and has been used as a building material for centuries. Building Regulations require a range of features in finished buildings to meet the high standards of fire protection applied to any other type of structure. The protection of a timber frame from fire is provided by the materials which cover the frame (eg plasterboards, plaster skim, tiles in non-combustible frames, appropriate insulating material etc). However, as with any other building during the construction phase and before the protective measures in the completed building are installed high standards of control are needed to prevent/control fires and protect people.

294 During the planning phase, careful consideration will need to be given to both the on-site and off-site fire risks. In built-up areas, designers, clients and (CDM) co-ordinators will need to evaluate the risk to surrounding premises. The risk will be greatest when the structure is erected but the protective measures are not yet installed. This period of maximum vulnerability, during which fire may spread quickly, must be considered in detail and minimised as part of the fire risk assessment. In situations where fire spread from a construction site might endanger the lives of people in adjacent properties, and effective precautions to reduce this risk to an acceptable level cannot be identified or implemented, alternative build methods with a lower fire risk must be adopted. Where sites are close to vulnerable property, such as residential or schools etc, the co-ordinator should discuss the risk with the fire service.

295 The principal contractor (main contractor on non-notifyable projects) will be in control of the site once the construction phase begins. The significant findings of the fire risk assessment, along with the action taken and the emergency procedures, should be incorporated in the construction phase plan prior to work commencing on site. The plan and precautions will need to remain under review as the project progresses. The principal contractor will need to liaise closely with sub-contractors – particularly the timber frame supplier – to make sure the necessary fire precautions and emergency arrangements are in place and understood before they start work on site.

296 Duty holders (including those who are Responsible Persons under the Regulatory Reform (Fire Safety) Order 2005) should give serious consideration to the use of timber and/or materials that have received an appropriate fire protection/retardant treatment for timber buildings. This will not only provide additional safety during the construction phase, but gives added protection for the completed building.

297 Large timber-framed structures should be subdivided into fire compartments at the earliest stage possible to prevent fire spread and ensure safe travel distances can be achieved for any personnel within the structure (see Table 1 – refer to paragraphs 190–196).

298 Where there are a number of timber-framed structures that are being built on one site, the risk of fire spread from one building to the next must be considered and controlled. For example, the installation of non-combustible materials such as the early completion of external façades can help to achieve this. This protection should not compromise any emergency exits.

299 The risk of the fire spreading to an adjacent property or properties outside the site perimeter should also be considered and, where necessary, controlled. There is more advice on managing fire safety in higher risk sites in Appendix 3 of HSG 168. While all of this is good advice, the more critical CDM Co-ordinator might ask whether some of these recommendations could actually be implemented.

For example Para 298, while clearly highly desirable, may actually be something which the contractor may consider to be impractical. Insurers’ concerns, which will inevitably relate more to questions of property protection rather than life safety, should also be taken into account – anecdotal evidence suggests that some construction risks insurers are increasingly reluctant to underwrite cover large timber-framed projects. Others may do so but may impose special terms and conditions.

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10 Author’s emphasis
11 This particular aspect is viewed by us as a critical issue and one that requires thorough assessment during CDM planning.
MANAGING FIRE SAFETY IN TIMBER-FRAMED BUILDING PROJECTS

The most likely conditions imposed by insurers will be those found in the Joint Code and it is worth noting that the most recent (7th) edition of the Code now classifies timber-framed buildings as being ‘high risk’.

The requirements of the Joint Code can be summarised as follows:
- Development of a fire safety plan in step with the building’s design and construction
- Appointment of a fire safety coordinator to implement the plan:
  - Fire risk assessments – to be undertaken and reviewed regularly as the project develops
  - Managing out fire risks such as electricity, smoking materials, ignition sources and flammable materials and gases
  - Controlling temporary buildings and structures
  - Provision of fire fighting equipment from Day One
- Managing waste
- Good materials storage
- Providing security against arson
- Hot work controls
- Training and induction of operatives
- Fire drills (including evacuation)
- Record keeping
- Liaison with the fire and rescue services

SO WHAT CAN BE DONE?

Given the clear risks of fires on this kind of site it is suggested that some of the conventional measures are still appropriate (for example, planning, risk assessment, housekeeping, control of specifically hazardous materials) but there is a greater need for regular checks and compliance inspections – especially during the stages of construction when unclad framework is in place. At the same time, early consideration should be given to the need for temporary, additional means of escape to be provided in the case of any structures which will reach 10m or above. This might include installation of additional ‘fire exit only’ ladders provided as a ‘last resort’ means of escape.

Perhaps the most effective way of protecting timber-framed structures, their site operatives and those who may be affected by fires in such buildings when being constructed is the provision of adequate fire compartmentation and fire barriers at the earliest possible stage. This will mitigate speed of fire spread. Equally effective in terms of limiting the impact on fires on neighbouring buildings is provision of adequate separation distances between individual structures on the site and also those structures and their proximity to the site boundary. While it is appreciated that especially in inner cities, open space is at a premium, nevertheless efforts should be made to minimise the ease with which fires can spread by radiation. On some sites, it may be possible to achieve this by delaying construction of some units while others are completed (or at least provided with their permanent fire barriers).

Other measures which must be considered and complied with are:
- Presumptions against hot work are recommended by many insurers and where such is unavoidable, then it should only be permitted by properly-audited method statements.
- Under no circumstances should open flame producing equipment be used within a timber framed building.
- Smoking should be prohibited and the controls effectively policed.
- Where hot work is permitted, it should be subject to a strict permit system where permits are issued only for the duration of the working day less 120 minutes.
- Regular removals of waste (especially combustible materials)

13 The Joint Code is referenced in the new HSE 118 guide to fire safety on construction sites and in the UKTFA ‘Guidelines’ and ‘Fire Safety on Timber Frame Construction Sites’.
14 For example, determining whether acetylene is actually required for a project or whether it can be replaced by a safer alternative such as propane.
15 Note that while the use of ladders to provide access to buildings under construction may be common on building sites, proper staircases provide safer access. Under the current fire safety regime ladders will not normally be recognised as a means of escape in case of fire.

APRIL ’11
SO WHAT CAN BE DONE?

• Enhanced training and tool box talk frequency
• Segregation of hazardous materials from the building under construction – especially flammable liquids and compressed gases. Consider prohibiting the use of acetylene
• Site security against arson (more than 65% of construction site fires are started deliberately. [See below]
• Constant reviews of means of escape in case of fire including site alarms, exit signs and lighting where necessary
• Provision of temporary fire protection measures (if the building’s own fire systems cannot be installed early) for example:
  o Temporary fire detection and alarm system
  o Temporary escape lighting
  o Adequate water for fire fighting – perhaps with a temporary site fire main on the largest sites
  o Temporary wet riser and hose reels to be installed on each level as soon as the previous level is complete
  o Consideration should be given to the provision of a temporary automatic fire sprinkler system for very large structures

ARSON AND SECURITY

It is a sad perspective of British society that the UK has one of the worst arson rates in the world. Around half of all fires in the UK are started deliberately and construction sites are particularly hard hit where some 62-65% of fires are caused by arsonists – many of them children.

The only way to prevent such crimes on a construction site is by the imposition of proper levels of security – that is, by keeping arsonists away from sites and in particular areas where easily ignited materials can be found. In the case of sites using timber framed construction this can be particularly difficult.

The precautions to be adopted will vary from site to site according to such factors as the size of the site, its location and the part of the country where construction is taking place. In general, as a minimum, the following should be considered:

• A perimeter/site boundary – this should be in the form of a fence or hoarding, continuous and not easily scaled or bypassed.

• Lighting – providing security and a safer workplace
• CCTV – including recording and retention of images.
• Security personnel, in the form of permanently guarded site entrances will be essential for larger sites and guards should be employed to make patrols of the site and its boundaries
• Very vulnerable locations – for example, areas where flammable liquids and gases are stored should be located away from the boundary and should be secured in purpose-built stores or vaults.
• Combustible materials such as timber and even waste should also be secured.
• Waste should not be allowed to accumulate but be removed regularly from site

Further advice on the prevention of arson can be found in the Joint Code and is also available from the Arson Prevention Bureau

INSURERS’ PERSPECTIVES

Insurers are increasingly relying on the terms of the Joint Code and many automatically designate larger timber framed buildings as ‘high risk’ so that the Joint Code applies as a warranty. Some, such as AXA have produced a special leaflet to provide guidance to their brokers and clients. Writing recently, AXA’s underwriting and operations manager said that it wanted to create an awareness of the risks of fires in the construction sites of timber framed buildings and wished to reduce the frequency and severity of the numbers of fires. They also want their clients to take steps to improve the fire security of their sites and physical assets.

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THE TIMBER-FRAMED INDUSTRY

While it is clear that the fires referred to (and others which are known to have taken place) have caused great concern to the suppliers of timber construction components and those builders and developers who favour such materials the industry position is that timber-framing offers considerable advantages over other building methods. It’s equally clear that government as a whole favours this method of construction as a solution to the need for more rapid construction of social housing and utilization of brown-field sites where timber-framing is thought to be particularly suitable.

It is worth noting that the timber-framed industry’s own guidance documents propose very sensible approaches to fire safety which largely mirror the Joint Code. In Fire Safety on Timber Frame Construction Sites, particular emphasis is placed on the need for a thorough fire risk assessment and regular reviews of this as well as the need for a proper site security programme to minimize the risks of and from arson. It is understood that the guidance is being reappraised and a series of revised documents will be issued which will almost certainly mirror the output from the CFOA-chaired WG mentioned earlier.

16 This is a special requirement included in some insurance contracts eg Munich Re Clause 112 “The wet fire fighting risers must be operational and must have an operating pressure of at least 6.5 bars at the highest water outlet.  
17 http://www.arsonpreventionbureau.org.uk/Publications/PDFs/IndustrialCommercial.pdf
THE CDM CO-ORDINATOR’S POSITION

Compliance with the CDM Regulations 2007 is fundamental, regardless of the type of construction and adherence to HSE guidance in HSG 168, together with the Joint Code of Practice, will ensure that the legal duties of the CDM Co-ordinator are complied with, that insurers are kept happy and that the fire and rescue service will be content. Do not forget that in the case of buildings undergoing refurbishment or being extended the enforcing authority for fire safety may be the fire authority rather than the HSE (See HSG 168 Paragraphs 346 - 367). Also do not overlook the importance of training and induction, surveillance, good record keeping and the possible benefits of advancing fire protection installation.

The ability of the CDM-Co-ordinator to assist is always enhanced by early appointment; the design decisions concerning the master planning of a site, or indeed the building envelope and site position are all fundamental issues. They are especially of interest if a decision is being considered to adopt a timber framed solution. Early appointment and engagement in the design team will be essential to help review and guide decisions on timber framed options and the consequential design and construction management arrangements that will be needed.

Under the beneficial controls provided by the CDM Regulations the treatment of construction fire risks and especially timber-framed structures should be no different by CDM duty holders in the construction team. Because the fire risk is both significant to construction workers and especially to the public, early and proper engagement of the CDM Co-ordinator with the design team will be essential. At the concept and feasibility stages what are the implications of a timber-framed solution as opposed to steel, concrete or brick and block (for example)? What about the footprint and the relationship to other existing buildings? Even if the risks can be managed what will be needed as an effective fire risk management plan that has to respond to the design and the site parameters? The global design implications are significant as they will need to meet the brief and the fire risk. At all phases of the project if a timber-framed solution is to be constructed then all aspects of the CDM Co-ordinator’s role will need to be engaged to ensure effective design and construction safety co-ordination:-

DESIGN AND PLANNING.

Location, structural design, proximity factors. Sequencing and use of materials; provision of protection, overall programme, alternative methodologies. Crossing the dividing line between “design” and “construction” will be a sensitive issue with some project teams. Designers obviously have a fundamental part to play with the CDM-C to ensure that design, sequencing and installation of protection can be achieved. This is an important aspect of a designer’s duty to supply information.

CLIENT ARRANGEMENTS.

Early advice to the Client from the CDM-C on timber framed fire risk issues in the design and construction phases will be fundamental. Working with the design team of course will be essential so that the project design solution is agreed and shared. The Client will need to be advised that the fire risks are significant and the planning and resourcing has to be the same. Firm and clear Client arrangements for the design phases and construction will be necessary. The Client needs to be behind the agreed risk management strategy as well as the anticipated benefits of timber framed structures.

A Design phase and construction phase fire risk strategy will need to be agreed, monitored and delivered.

PRE CONSTRUCTION INFORMATION.

The CDM-C has the role and responsibility to identify and support the design and construction information process. The on and off-site risks must be identified. Ensuring that information is effectively communicated within the whole design and project team is a key role of the CDM-C.

CONSTRUCTION PHASE PLAN.

Fire risk management planning and execution become fundamental aspects for the Construction Phase Plan; the CDM-C has a vital role here to review the proposed arrangements for construction phase fire risk management. For a timber framed structure, as the on and off-site risks are potentially great, the proportional response rule must apply. Planning the site arrangements, the personnel, sequencing, fire protection, emergency procedures and waste management and security measures all become critical detailed requirements which will require resourcing. The Client should be carefully informed about the advice given at the point the Client can authorise commencement of the construction phase.

HEALTH AND SAFETY FILE.

The major phases of foreseeable construction related work on the timber-framed structure should be reflected in the Health and Safety File. The risks posed during the construction phase (before full fire protection is installed) and the ultimate demolition that presents the reverse problem.
CONCLUSIONS

The wider use of timber-framing and its application in larger buildings has resulted in some significant, costly fires. Such fires have the potential to involve injury and life loss as well as destroy buildings under construction and also spread to nearby structures.

There is a great deal of activity being undertaken to try to make this method of building as safe from fires during construction as practicable. It is essential that those practitioners who work in this sector remain alert to new and changing guidelines issued by the regulators, the fire service and the timber-framed industry itself. While there may be pressure to restrict very large timber-framed buildings they offer significant advantages in certain circumstances and the technique is unlikely to be banned or subject to further controls. The existing public domain guidance on managing fire safety on construction sites is still highly relevant and if followed should ensure that the probability of a fire is reduced and if one should occur, its impact will be minimized.

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