

Fire risk during construction – design and specification implications

Following a number of recent major fires on construction sites, Neil Storkes, NBS Technical Author and Architect, summarizes the requirements of the CDM Regulations, current fire legislation and HSE guidance, and reviews the implications for the design and specification of projects.

The Construction (Design and Management) Regulations 2007

The CDM Regulations place duties on all who contribute to the health and safety of a construction project. For notifiable projects (lasting more than 30 working days or involving more than 500 person days), additional duties are placed on clients, designers, CDM co-ordinators, principal contractors and contractors, including production of a project specific construction phase plan and health and safety file.

Designers are defined as those who carry out design work for a construction project, including site preparation and temporary works. Designers may include architects, consulting engineers, surveyors, interior designers, temporary work engineers, technicians, specifiers, principal contractors and specialist contractors. Under the CDM Regulations, design work includes the preparation of drawings, design details, specifications and pricing documents. Design work may be recorded (digitally or on paper) or communicated verbally and anyone (including a client) who prepares or alters a design may be considered as a designer.

Regardless of the size, duration or nature of a project, designers have particular responsibilities under the CDM Regulations. From a project's earliest stages their decisions can make a significant contribution to the occurrence or elimination of construction health and safety hazards.

With regard to the management of fire risk, the CDM Regulations place particular responsibilities on 'duty-holders'. Regulation 38, Prevention of risk from fire etc. states that – 'Suitable and sufficient steps shall be taken to prevent, so far as is reasonably practicable, the risk of injury to any person during the carrying out of construction work arising from

1. fire or explosion;
2. flooding; or
3. any substance liable to cause asphyxiation.'

Current fire legislation

National Building Regulations in England, Wales, Scotland and Northern Ireland stipulate the rules and degree of fire resistance for elements of structure for completed buildings. Fire legislation in the United Kingdom changed with the introduction of the *Regulatory Reform (Fire Safety) Order 2005* (RRFSO) in England and Wales, the *Fire (Scotland) Act 2005* (FSA) and the *Fire and Rescue Services (Northern Ireland) Order 2006 – Part 3/ Fire Safety Regulations (Northern Ireland) 2010*. There are differences in detail between the various pieces of legislation, but the fundamental requirements are the same. Building owners and

employers are required to identify potential fire risks and take necessary measures to reduce or eliminate those risks by conducting comprehensive risk assessments. Designers, specifiers and contractors have a key responsibility in communicating to owners and employers all elements of the design and construction that may affect the fire risk assessment, including the anticipated fire performance of all proposed construction materials and particularly the specification and use of combustible materials.

This method of shared responsibility for identifying fire hazards underlines a drive to make all parties more accountable for fire safety.

Current legislation requires that those with control over construction work can demonstrate that they have:

- Identified the risks in their workplaces
- Considered who will be affected
- Assessed the extent of the identified risks
- Come to an informed decision on the necessary action to reduce all identified risks
- Ensured that all necessary actions have been fully implemented.

The RRFSO defines the term 'responsible person' and where that person implements any preventative and/ or protective measures, they must do so on the basis of the principles specified in Part 3 of Schedule 1 of the RRFSO. These are essentially the same as eight of the nine 'principles of prevention' listed in Appendix 7 of the CDM Regulations. The RRFSO principles are:

1. Avoiding risks
2. Evaluating the risks which cannot be avoided
3. Combating the risks at source
4. Adapting to technical progress
5. Replacing the dangerous by the non-dangerous or less dangerous
6. Developing a coherent overall prevention policy which covers technology, organisation of work and the influence of factors relating to the working environment
7. Giving collective protective measures priority over individual protective measures
8. Giving appropriate instructions to employees.

From concept, throughout the design phase and during the construction phase, 'responsible persons' must consider the risks from fire. They should share information, cooperate and execute their legal duties under CDM to ensure all risks from fire are reduced as far as is reasonably practicable.

The RRFSO is equally relevant both during construction and occupation of premises.

HSG 168 – Fire safety in construction (second edition 2010)

This HSE document is part of a suite of guidance documentation in support of the CDM Regulations. It applies to all construction projects and is intended for everyone with a role in developing, managing and applying safety standards on site (clients, co-ordinators, designers, planners, contractors and workers).

HSG 168 emphasizes the principle that construction fire safety must be considered from the earliest stages of the design and procurement process and then implemented effectively

during the construction phase. During the design phase the designer needs to identify the particular risks that may arise to persons from fire and explosion during the construction phase (including the risks to those on site and in adjacent buildings).

Together with other recent legislation and guidance, HSG 168 identifies that while completed buildings should have the standards of fire protection required by national Building Regulations (and other associated legislation), the building will be more vulnerable to fire during construction and before final fire protection is in place. This increased vulnerability may result in large areas of building fabric and structure suffering fire damage, with the significant risk of fire spread on and off-site. Therefore, the problems associated with buildings being more vulnerable to fire during construction must be carefully considered early in the design process and appropriate measures taken to minimize risk.

For projects involving the refurbishment and/ or extension of existing buildings it will be important to take into account the age and construction of the existing premises, together with any existing arrangements for emergency evacuation (particularly those available for evacuation of site personnel during construction works).

The designer, together with the client, CDM co-ordinator and principal contractor, should determine the stages at which the fire safety provisions present in the final building/structure will be complete. This allows the degree of risk and period of exposure to that risk during the construction phase to be established. In the case of refurbishment or demolition projects, the assessment should include the stages at which existing fire safety provisions will be stripped out or compromised, exposing vulnerable building elements (e.g. structural timber floors) to the risk of fire.

Establishing the degree of risk is particularly important in building types which are more vulnerable than others to fire during the construction phase. Particular mention is made in HSG 168 of timber framed buildings and those using composite metal panel cladding, examples of both having suffered recent and well publicized catastrophic fires during the construction phase before external and internal finishes are installed.

Based on the potential for fire during the construction stage, the need to address the risks to both on-site personnel and off-site neighbours may require:

- The rejection of particular methods of construction and materials in a particular location (e.g. adjacent to a site boundary or occupied building)
- The inclusion of more demanding material specifications (e.g. external wall sheathing or cladding with limited or no combustibility)
- The inclusion of expensive temporary mitigation measures (e.g. sprinklers).

The additional costs involved in providing such measures may be prohibitive and make it necessary to specify alternative construction methods or materials from the outset.

United Kingdom Timber Frame Association guidance

The UKTFA have consulted with the HSE and published a series of guidance documents for the design and specification of multi-storey timber framed buildings. The guidance is applicable to a single timber framed building with a total floor area greater than 600 m², or two or more blocks where each block has a total floor area greater than 300 m². This

guidance focuses on establishing safe separation distances for timber framed buildings during construction, and lists various construction specification options to enable those distances to be optimized. It should be noted that the UKTFA's guidance for separating distances during construction is not a mandatory requirement and is more demanding than current requirements for completed buildings in Approved Documents B1 and B2 of the Building Regulations in both England and Wales.

The UKTFA guidance also refers to the reaction of whole timber frame systems (e.g. walls and/ or floors) to fire on a construction site. British and European standards (e.g. BS 476 and BS EN 13501) provide fire performance data for products or elements in isolation. BS 476, BS EN 1363 and BS EN 1365 dictate the appropriate fire tests and grade the level of fire resistance for elements of structure and materials.

The guidance presents three generic categories of timber frame with increasing resistance to fire spread and associated reduction in radiant heat to neighbouring properties:

- Category A - Standard open panel timber frame
- Category B - Reduced fire spread timber frame
- Category C - Fire spread resistant timber frame.

The UKTFA *Design guide to separating distances for timber frame buildings during construction* comprises the following parts:

- Part 1. Background and introduction
- Part 2. Standard timber frame and construction process mitigation methods
- Part 3. Timber frame build methods to reduce the separating distances
- Supporting documents:
 - Technical Paper 1. Separating distances technical background report by UKTFA fire engineering consultants - FERMI
 - Technical Paper 2. Summary of timber frame categories to reduce separating distances and information for fire engineering modelling and test compliance requirements for each category
 - Technical Paper 3. Product test methodology for category compliance
 - Product Paper 1. Flame Retardant - FR Build product compliance
 - Product Paper 2. Insulation - FI Build product compliance
 - Product Paper 3. Sheathing and decking - FC Build product compliance.

The UKTFA state that their guidance '*enables the designer to specify a type of timber frame system, either with external mitigating measures or inherent mitigation measures, so that radiant heat emissions will be limited during a fire on a timber frame construction site, to below a level that has been accepted as appropriate to reduce the risk of spreading fire to a neighbouring building.*'

Summary

- Current fire and CDM regulations require the removal or significant reduction of fire risk during construction
- As a CDM and RRFSo 'responsible person', a designer must execute legal duties under CDM by:

- Considering all risks from fire from project conception, throughout the design phase and during the construction phase. Design and specification decisions should be well informed and made to ensure all risks from fire are reduced to be as low as reasonably practicable
- Communicating to owners and employers all elements of the design and construction that may affect their fire risk assessment, including the specification and use of combustible materials.
- National Building Regulations define fire performance standards for completed buildings and elements
- Most available fire performance data for construction elements and products is based on the laboratory testing of sample specimens configured to represent complete installations
- Early reference to HSE guidance, particularly HSG 168 – 'Fire safety in construction', is essential for all projects
- To enable designers to meet their obligations as defined in the CDM regulations and other associated legislation, specialist guidance such as that provided by the UKTFA should be used to inform early design decisions such as site usage, the placing and orientation of individual buildings or elements, and the proposed use of particular construction methods and materials
- Manufacturers should make comprehensive data on the fire performance of individual construction products and materials more accessible to specifiers
- Designers should consider the detailing of vulnerable elements (e.g. timber frame) to allow earliest possible completion of that part of the building envelope. Also, combustible materials (e.g. structural timber) should be specified with fire retardant treatments to improve their fire performance during construction, even if such treatments are not required for the completed building.

References

Construction (Design and Management) Regulations 2007 (CDM)

Regulatory Reform (Fire Safety) Order 2005 (RRFSO)

Fire (Scotland) Act 2005 (FSA)

Fire and Rescue Services (Northern Ireland) Order 2006 – Part 3/ Fire Safety Regulations (Northern Ireland) 2010

HSG 168 (HSE)

UKTFA publications:

- *Design guide to separating distances during construction – part 1*
- *Design guide to separating distances during construction – part 2*
- *Design guide to separating distances during construction – part 3*
- *UKTFA risk assessment checklist*
- *16 Steps to fire safety – promoting best practice on timber frame construction sites*

Related NBS information:

Articles:

- [Video: Fire Stopping](#)
- [Making timber frame structures safer](#)
- [Passive Fire Protection – the effects of the *Regulatory Reform \(Fire Safety\) Order*](#)

Article updated July 2013 for separation of England and Wales Building Regulations and to include reference to Northern Ireland fire legislation