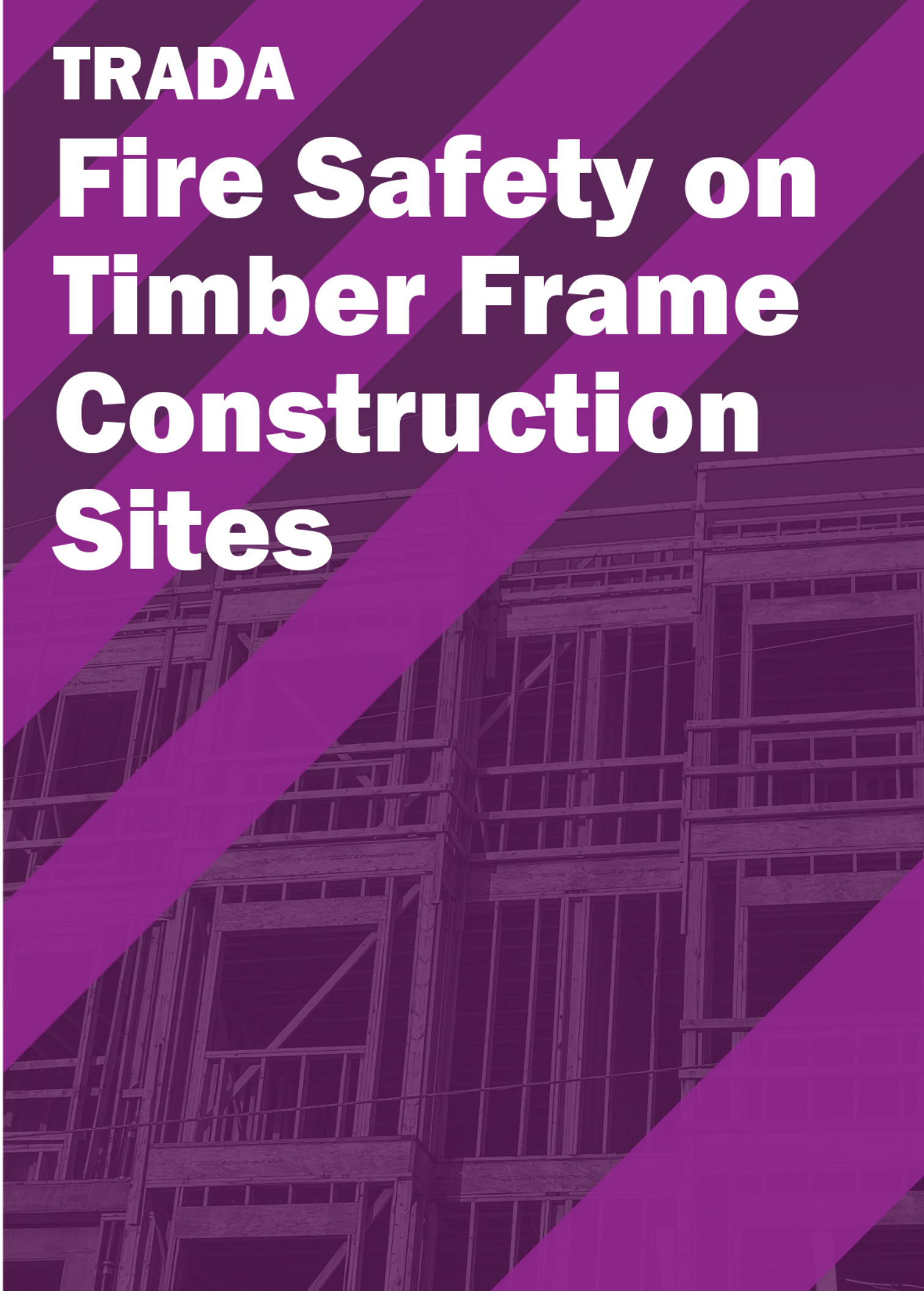
CONSTRUCTION FIRE SAFETY COALITION

TRADA

Fire Safety on Timber Frame Construction Sites



Fire safety on timber frame construction sites

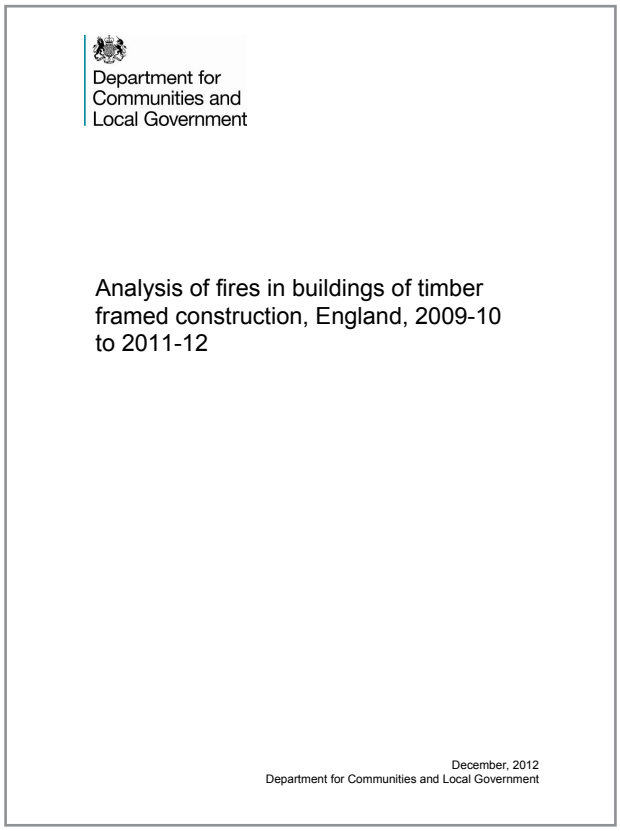
1 Background and history

All buildings must be constructed to meet national building regulations, which include requirements for fire resistance. These regulations do not cover building under construction and only come into effect once the building is completed. Timber frame buildings meet and can exceed minimum building regulations. This construction briefing explores fire during construction, not post construction. TRADA's Wood Information sheet "Fire performance of timber frame dwellings" provides information on completed dwellings.

The Communities and Local Government Fire Statistic Monitor publishes quarterly statistics on fires, casualties and false alarms attended by fire and rescue services in the United Kingdom. See http://www.communities.gov.uk/fire/researchandstatistics/firestatistics. TRADA's Construction Briefing *HSG168 Fire Safety on Construction Sites* includes a summary of statistics from these documents, which concludes that timber frame is significantly less prone to experiencing fires than other forms of construction. In all honesty this is influenced by social factors rather than the building type. This is because under our current functional building regulations approach the build type is largely irrelevant in most fire incidents.

Fire is an emotive word. When considering an unplanned event it can describe anything from a small fire brought quickly under control, to a large destructive and life threatening scenario requiring attendance of emergency services. There are around 11 construction site fires in the UK every day, so as you read this, there may be one occurring somewhere. These fires occur on sites across all sectors of the construction industry and it has been estimated that two thirds of them are started deliberately.

In the Western world, timber frame commands a large percentage share of the housing market. Other countries have not faced the large timber frame site fires which the UK has and struggle to understand what the problem is and why the UK now needs to consider it – timber frame buildings do not spontaneously combust. There has been a pattern to the reported large timber frame construction site fires. They occur at times when sites are closed, during evenings and weekends, and when the timber frame structure is not protected by internal linings or external claddings. The problem therefore generally seems to be one of arson and the requirement is to protect sites from trespass and reduce the risk of deliberate site fires from starting or spreading.


Department for Communities and Local Government

Analysis of fires in buildings of timber framed construction, England, 2009-10 to 2011-12

December, 2012
Department for Communities and Local Government

CLG statistics for 2010-2012 separated out fire statistics for timber frame vs other forms of construction, providing clear evidence that completed timber frame buildings are at least as safe as other forms of construction.

Many construction site fires are small and quickly extinguished with minimal damage, so are generally unreported in the media. It is larger fires, or fires which lead to loss of life that make the headlines. No loss of life has occurred due to fires starting on timber frame sites. However, no matter how large or small the fire, the issue must be suitably managed. In the summer of 2006 a 6 storey timber frame building in Collindale, North London caught fire during construction. A few other large timber frame sites also experienced construction site fires in the following years, turning attention to the timber frame industry and prompting them to take action.

Large timber frame sites can have high volumes of combustible materials present. With lots to combust, the heat energy generated means that fire fighting strategy is often one of containment rather than to extinguish. There are many significant benefits to timber frame construction, including speed of construction and sustainability. These cannot be ignored because of a relatively small risk of fire.

2 16 Steps to fire safety

Following a series of fires on sites using timber frame construction during 2006 and 2007, some competitor sectors, end users and insurers began to raise questions about the safety of this method, primarily because of the rapid fire spread and collapse of unprotected frames. The response from the United Kingdom Timber Frame Association (UKTFA) and Wood for Good was to consult with the Health and Safety Executive, the London Fire Brigade, fire engineers and others. In July 2008 they launched *16 Steps to Fire Safety*, a booklet providing practical advice on how to protect timber frame sites and reduce the risk of fire. It still provides the backbone for key decision-making processes when setting up and running a timber frame site of any size. Although not a compulsory document it has been regularly used by HSE as part of their site inspections.

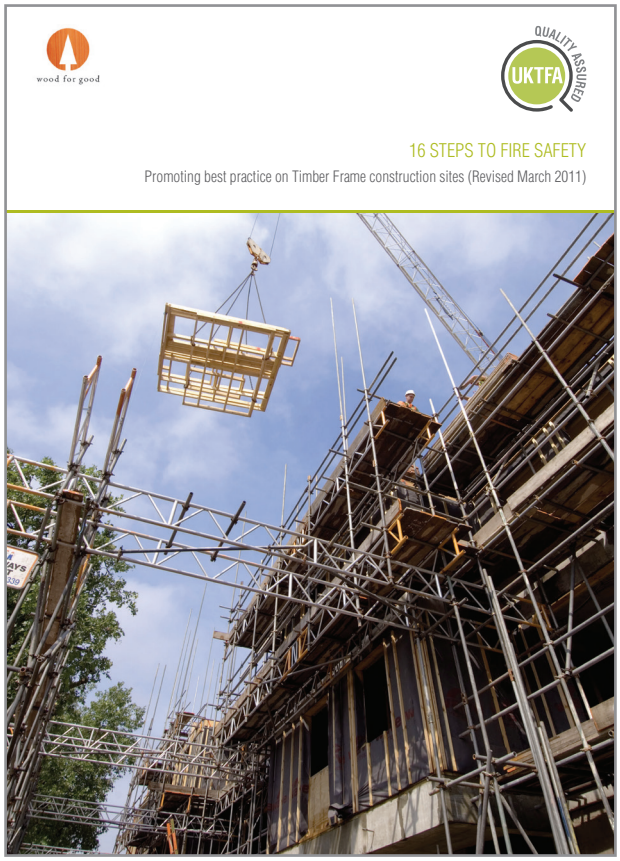
The 16 steps are:

1. Compliance with CDM 2007
2. The Fire Safety Co-ordinator
3. The Site Fire Safety Plan
4. Checks, inspections and tests throughout construction
5. Communication and liaison
6. Promoting a “fire safe” working environment
7. Fire detection and warning
8. Protecting emergency escape routes (the 35m rule)
9. Building in fire protection along the way
10. Site Security against arson
11. Protecting temporary buildings and accommodation
12. Safe storage of materials
13. Designing out hot works
14. Keeping a tidy site
15. Dealing with plant and equipment
16. A “no smoking” site

Each step is explained in the booklet which is available from the UKTFA website (www.uktfa.com). The titles of many of these steps are self explanatory, common sense and have been required previously under CDM; but it reinforces the points further in one concise document. The 16 steps guide confirmed the need to subdivide against fire during construction and defined minimum levels of security, dependant on the height and size of the building. The aim being that if a fire were to break out, the vertical breaks would slow the growth of fire to allow the workforce to escape.

3 Site safe

With further fires still occurring during the summer of 2009, the UKTFA decided to take additional action to reinforce guidance provided in the “*16 Steps to Fire Safety*” booklet. By December 2009 they were ready to launch their “Site Safe” initiative.



UKTFA 16 steps to fire safety

As a condition of membership, all manufacturing member companies of the UKTFA have to adopt “SiteSafe” practices. In addition to the 16 steps procedure, for large projects (4 storeys or more and/or with an aggregate floor area of more than 2,500 m^2) they are required to register the project on the CFOA (Chief Fire Officers’ Association) website to encourage the main

contractor to engage with the 16 steps. This commences with pre-construction planning, then erection of the timber frame on site and lastly the hand-over of the structure. Its aim is to ensure that all contractors involved in timber frame sites are aware or fire risks during the whole construction phase. While the responsibility for addressing the fire risk lies with the principal contractor, SiteSafe provides a framework through which risks can be consistently communicated, so that appropriate action can be taken. To aid compliance the SiteSafe scheme includes random independent audits of UKTFA members' construction sites which are registered under the scheme to check that the UKTFA member has complied with its duties.

SiteSafe has been approved by the Chief Fire Officers Association. One of its requirements is to inform the local Fire and Rescue Service about the presence of a timber frame construction site nearby. This allows them to develop a response and action plan for resources should a fire occur. To reinforce this further, in November 2011 the SiteSafe Online Notification system was launched by the Chief Fire Officers Association. It has been developed by them in conjunction with the UKTFA and other interested parties to enable electronic notifications about timber frame construction sites in their area. At the same time it registers the site with the UKTFA SiteSafe scheme.

4 HSE fire safety in construction HSG 168 (2nd Edition - October 2010)

In October 2010 the HSE published their revised document HSG168 Fire safety in construction. It is a 95 page guidance document aimed at all methods of construction which now includes a section specifically for timber frame buildings. TRADA has written a Construction Briefing titled *HSG 168 Fire Safety on Construction sites* summarising its contents.

As a guide to those involved with CDM requirements it reinforces good fire safety on site and introduces the need on large sites to consider the risk of fire spreading off site to adjacent buildings. Carrying out a fire risk assessment on a building under construction, to include neighbouring buildings was new, and there was no accepted methodology in place. The timber frame industry identified a need to provide concise and accurate information to main contractors on how this could be assessed. They also needed to provide appropriate recommended steps to ensure that timber frame structures would still be a practical form of construction on any given site. This spawned industry working groups whose aim was to provide the necessary guidance.

5 UKTFA separating distances guide (Dec 2012)

Following the publication of HSG168 *Fire safety in construction*, a timber frame working group was established by the UKTFA to produce guidance on separating distances when building with timber frame. The Health and Safety Executive, the Fire Protection Association, the Chief Fire Officers' Association and the Fire Brigade Union all played an active part in the working group. Due to the lack of established methodology for such situations a considerable amount of test data had to be gathered. Rather than gathering test evidence for individual materials, the decision was taken to carry out holistic testing of room scale structures up to 2 stories high. During 2011, testing, analysis and calculations were carried out to draft *Design guide to separating distances during construction* launched by the UKTFA in December 2011. The update of this guidance is now available, dated December 2012, at the UKTFA website, www.uktfa.com.

The published guidance is aimed at buildings exceeding 600m^2 of total floor area. It is divided into 3 main parts, plus supporting documents. Part 1 of the guidance provides terminology and background. Part 2 provides guidance on the use of standard timber frame and construction process mitigation measures; Part 3 provides the user with timber frame methods to reduce the separating distances.

Part 1 - Background and introduction

The guidance is intended to be used from the design phase of a project as the basis for the development of a site fire risk plan to address the risk assessment requirements of HSG168. Specialist fire engineers should be employed for sites which are particularly onerous, or where specific risk factors make the guidance too conservative. The guidance has been written to provide a consistent, appropriately conservative methodology to assess the fire risk to neighbouring buildings should a fire occur in a timber frame building during construction.

Firstly, three generic categories of timber frame are given, each with increasing resistance to fire spread on site. These categories allow the design team to write a specification for a timber frame building for any site condition, relating to separating distances from 0m onwards.

Category A - Standard open panel timber frame

Category B - Reduced fire spread timber frame

Category C - Fire spread resistant timber frame

The level of heat received by the neighbouring property is determined in the main by the temperature and size of the fire in the burning building, and the separating distance that heat has to cross. In determining the acceptable threshold distances for radiant heat on a receiving surface the following factors have been taken into consideration:

- The use of the neighbouring building
- The facade of the neighbouring building
- The site conditions and wind
- The site terrain
- Site operations
- The growth of fire
- The acceptable threshold level of radiant heat on a given surface
- Building size.

Part 2 - Standard timber frame and construction process mitigation methods

Part 2 of the guidance has a number of tables and diagrams to work out the recommended separating distances for standard timber frame (Category A). It considers the length and height of the timber frame structure (the emitter), its height above ground, how it and its distance from an existing building (the receiver).

It allows for risk mitigation where necessary, through improvements such as using concrete podium slabs for lower storeys. Non-combustible cladding could be constructed alongside the timber frame on affected elevations as work proceeds. These measures reduce the risk of fire from the timber frame spreading over distance.

If the building in its proposed location, size and shape does not meet the separating distances from existing buildings set out in the tables, then action must be taken. It may be possible to move the proposed building, or alter its shape to meet requirements. If not, the process should move to consider category B or C measures with methods to reduce fire spread or make the timber frame fire spread resistant.

Part 3 Timber frame build methods to reduce the separating distances

Part 3 deals with timber frame build methods to reduce separating distances. In situations where it has not been possible to meet requirements for standard timber frame (Category A), it is necessary to specify reduced fire spread timber frame (Category B) or fire spread resistant timber frame, (Category C) construction. As with Category A, Category B and C have tables and diagrams detailing separating distances between emitter and receiver buildings. These distances become shorter, due to the materials and methods used providing better protection against fire spread. Categories B and C are further sub-divided into B1, B2, B3, C1 and C2.

The UKTFA, in conjunction with members of the timber frame working group including the HSE, FPA, CFOA and FBU have developed a test method which can be used to categorise different types of timber frame construction. Testing of certain timber frame build methods, (i.e. wall and floor panels) has demonstrated that radiant heat and growth of fire can be reduced using a variety of methods.

FR Build is a classification of flame retardants acceptable to the UKTFA based on the Wood Protection Association (WPA) benchmark audit scheme and approvals. FI Build is a classification of appropriate insulation material acceptable to the UKTFA. i.e. insulation products suitable for off-site

Number of timber frame storeys	Emitter length (eL)						
	≤5m	≤10m	≤15m	≤20m	≤25m	≤40m	>40m
1	5.5	7.25	8.25	8.75	9.5	10.25	10.5
2	7.5	10.5	12.75	14.25	15.5	18	20.25
3	9	13	16	18	20	23.25	28.5
4	10	15	18.5	21.25	23.5	28.5	35.75
5	11	16.5	20.5	23.75	26.5	32.5	41.75
6	11.5	18	22.5	26	29	36	47.25
7	12.25	19	24	28	31.5	39.25	52.5

Timber frame separating distance (m) for Category A build types, taken from UKTFA 'Design guide to separating distances during construction'.

Number of timber frame storeys	Emitter length (eL) - B1 Frame			
	≤5m	≤10m	≤15m	<20m
1	5	5.5	6.25	6.5
2	6	8.25	10	11
3	7	10.25	12.5	14.25
4	7.5	11.75	14.5	16.75
5	8.25	13	16	18.75
6	8.75	14	18.75	20.25
7	9	14.75	18.75	22

Timber frame separating distance (m) for Category B1 build types, taken from UKTFA 'Design guide to separating distances during construction'

Number of timber frame storeys	Emitter length			
	≤5m	≤10m	≤15m	≤20m
1	5	5	5	5
2	5	5	5	5
3	5	5	5.75	6.5
4	5	5.5	7	7.75
5	5	6	7.75	8.75
6	5	6.25	8.25	9.75
7	5	6.5	8.75	10.25

Timber frame separating distance (m) for Category C1 build types, taken from UKTFA 'Design guide to separating distances during construction'

installation e.g. rigid polyisocyanurate and phenolic insulation products and mineral wool products that can be protected from the weather. FC build is a classification of appropriate sheathing and decking products. Dependant on the type of walls and floors being considered, there are a number of alternatives which are summarised below and in table.

The use of FR treated timber external wall framing and floor joists, plus FR treated (or of at least limited combustibility) wall sheathing and floor decking provide the bulk of solutions for Category B: Reduced fire spread timber frame.

To achieve Category C1, external wall specification has to be increased further to use non-combustible or limited combustibility sheathing. Category C2 can only be achieved in areas with no openings and this highest specification offers fire spread resistant frames.

As testing and appraisals of new materials and methods continue, new alternatives may be acceptable. The UKTFA website provides product compliance requirements in their Product Papers 1 – 4.

The measures laid out in the UKTFA documents offer an easy to use method of proving compliance with required risk assessment procedures. Although they offer a number of alternative paths for a variety of situations, their simplicity addresses many sites but additional benefits may be achieved by engaging a competent fire engineer to reduce separation distances or the solutions required.

6 Other risk management measures

Heat and smoke alarms are becoming a common sight on construction sites. They are suitable for outdoor use, with wireless technology and battery power allowing for easy installation, relocating during works and removal, often without the need for cabling. They provide site wide coverage for detection of smoke, heat and as a manual fire alarm if required. The alarms allow for fast alert of an incident, making it more likely to be safely contained without loss of life or property. Their specification is a logical step in any timber frame site risk assessment. The UKTFA has guidance on their website on alarm systems, which is updated to reflect new developments and experiences in this area.

Temporary automatic sprinkler systems can be a very effective means of reducing the spread of fire as they target the seat of the fire directly and immediately assuming the fire starts internally and that there is sufficient water available to power sprinkler systems, A sprinkler system operates when heat causes the sprinkler head to open, releasing water or foam from the sprinkler head. However, if used to reduce the risk on timber frame sites during construction, temporary sprinklers would need to be carefully installed, extended as work proceeds and maintained to be effective. They would also need to be either built into the finished structure, or adapted around following trades for later removal. The UKTFA is looking into the effectiveness and acceptability of using sprinklers in this temporary manner on timber frame sites during construction and a report is due out at the end of 2013.

Effective site security is critical for reducing arson on construction sites. If intruders break through a site perimeter fence, their presence may go unnoticed even by an on site security guard. Many sites are now moving towards remote monitoring. Modern remote camera systems using motion

Timber Frame Category	Location				
	External Walls	Load Bearing Internal Walls	Compartment Walls / Fire Compartmentation	Floor / flat roofs[g]	Pitched Roofs
Category A **Timber Frame and Structural Insulated Panels (SIPS).**	Timber frame and sheathing[d] SIPS with timber facing[h]	Timber frame and sheathing[d] SIPS with timber facing[h]	Timber frame and sheathing[d] ***Note: sheathing of limited combustibility or better at max centres of 25m for UKTFA 16 Steps requirement***	Timber joists and decking[e]	Timber roof members and trusses
Category B **Reduced fire spread frames[i]**	**B1** FR Build[a] frame and FR Build[a] sheathing or sheathing of limited combustibility[c] or better ***Note: Insulation type F1 Build 1[f]***	**Sheathed walls** FR Build[a] frame FR Build[a] sheathing or sheathing of limited combustibility[c] or better **or** Timber frame not FR treated with non-combustible[c] boards on one face of the wall frame[i] **Unsheathed walls** FR Build[a] framing	FR Build[a] frame FR Build[a] sheathing or sheathing of limited combustibility[c] or better, plus party wall cavity insulation **or** Timber frame not FR treated with non-combustible[c] boards on one face of the wall frame either room side or party wall cavity face[i] ***Note: For this guidance maximum centres is 20m between compartment walls to break up the frame layout to reduce the emitter lengths***	FR Build[a] joists FR Build[a] boards or boards of limited combustibility[c] or better	Not FR treated roof members and trusses for pitches 15 to 55 degrees. Otherwise take as flat roof construction
	B2 as B1, plus pre insulated with type F1 Build 2[f]				
	B3 as B1, plus pre insulated with type F1 Build 3[f]				
Category C **Fire spread resistant frames[i]**	Timber frame not FR treated, with non-combustible sheathing on one side, open on the other side (no combustible sheathing on the wall)[i] **or** FR Build[a] timber frame with sheathing of limited combustibility[c] or better **or** FR build[a] frames internally faced with boards of limited combustibility or better and FR Build[a] sheathing externally or better (includes pre insulated - type F1 Build 1-3)[f]				
Category C2 **Fire spread resistant frames no openings**	As C1 but no openings and external sheathing to be at least sheathing of limited combustibility[c] ***Note: openings can be temporarily closed off with sheathing of limited combustibility***				

a. *Notes*

b. *FR Build is a classification of flame retardants (including intumescent coatings) acceptable to the UKTFA based on the Wood Protection Association (WPA) benchmark audit scheme and approvals. EN or BS reaction to fire or fire test data is not acceptable. See supporting Product Paper 1.*

c. *Non-combustible boards will be products complying with BS 476 - part 4 or BS EN ISO 1182 euro class A1.*

d. *Boards of limited combustibility shall be products that comply with BS EN ISO 13823 euro class A2 and BS 476 - part 11.*

e. *Standard timber frame - typically combustible materials not treated with flame retardants.*

f. *Standard joists and decking - typically combustible materials not treated with flame retardants.*

g. *FI Build is a classification of appropriate insulation material acceptable to the UKTFA. i.e. insulation products suitable for off the site installation e.g. rigid polyisocyanurate and phenolic insulation products and mineral wool products that can be protected from the weather. See supporting Product Paper 2.*

All insulation material to FI Build classification. The UKTFA website provides the list of products that have been tested under the UKTFA methodology for type FI Build 1, type FI Build 2, type FI Build 3. Product Paper 2 provides information for the insulation companies on the assessment process.

h. *Flat roofs are included, as the exposed decking combined with the exposed joists supports or contains fire growth depending on the treatment and ignitability of the materials. Summary of roof consideration below:*

For roof pitch less than 15 degrees	Shall be treated as the relevant category floor assembly
Roof pitch equal to 15 degrees and up to 55 degrees	In Category B and C may be standard timber components
Room in the roof and Mansard roofs great than 55 degrees pitch	To be considered as an additional story of timber frame

i. *Structural Insulated Panels (SIPS) typically have a combustible timber sheathing board to either side of the insulation. It is the combustibility of the sheathing board that places the SIPS into Category A.*

j. *The use of non combustible boards to one side of the frame is based on the fact that there is no combustible sheathing exposed to a potential fire on either side of the frame.*

k. *The UKTFA Product Paper 4 provides the timber supply chain and fire engineers with technical data to support the delivery of Category B and C solutions.*

l. *Non load bearing walls (unsheathed) are untreated timber regardless of the category of timber frame.*

Categories of timber frame build methods that enable reduced separating distances during construction.

detectors and infra-red sensors can alert off-site camera operators who can view the incident immediately and identify the situation, eliminating any false alarms. In the event of an intrusion, the operators can directly address the perpetrator with a live audio challenge, which in the majority of cases, results in them leaving the site. The UKTFA has published papers on security on their website and will be producing a paper on remote monitoring in Summer 2013.

Further help

TRADA members may contact the Members' Helpline for free on t: 01494 569601.

Further resources

Wood Information Sheet
4-30 Fire performance of timber frame dwellings
http://www.trada.co.uk/bookshop/view/1D283468-3E29-44E6-B2EA-190CC2DED833/Fire_performance_of_timber_frame_dwellings

Construction Briefing
HSG 168 Fire Safety on Construction Sites
http://www.trada.co.uk/downloads/constructionBriefings/
http://www.trada.co.uk/downloads/constructionBriefings/HSG%20168%20Fire%20Safety%20on%20Construction%20Sites%20V2.pdf

UKTFA guidance on fire safety on construction sites
http://www.uktfa.com/download-documents/

Chief Fire Officers' Association (CFOA) website
www.cfoa.org.uk

TRADA Construction Briefings

This document is part of a series of briefings for TRADA members on the key elements of building regulations and codes and how they relate to timber construction. Copies of all briefings are available at www.trada.co.uk.

Feedback

We welcome feedback from readers and if you have any comments on the content of this briefing please contact us using the information below.

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