



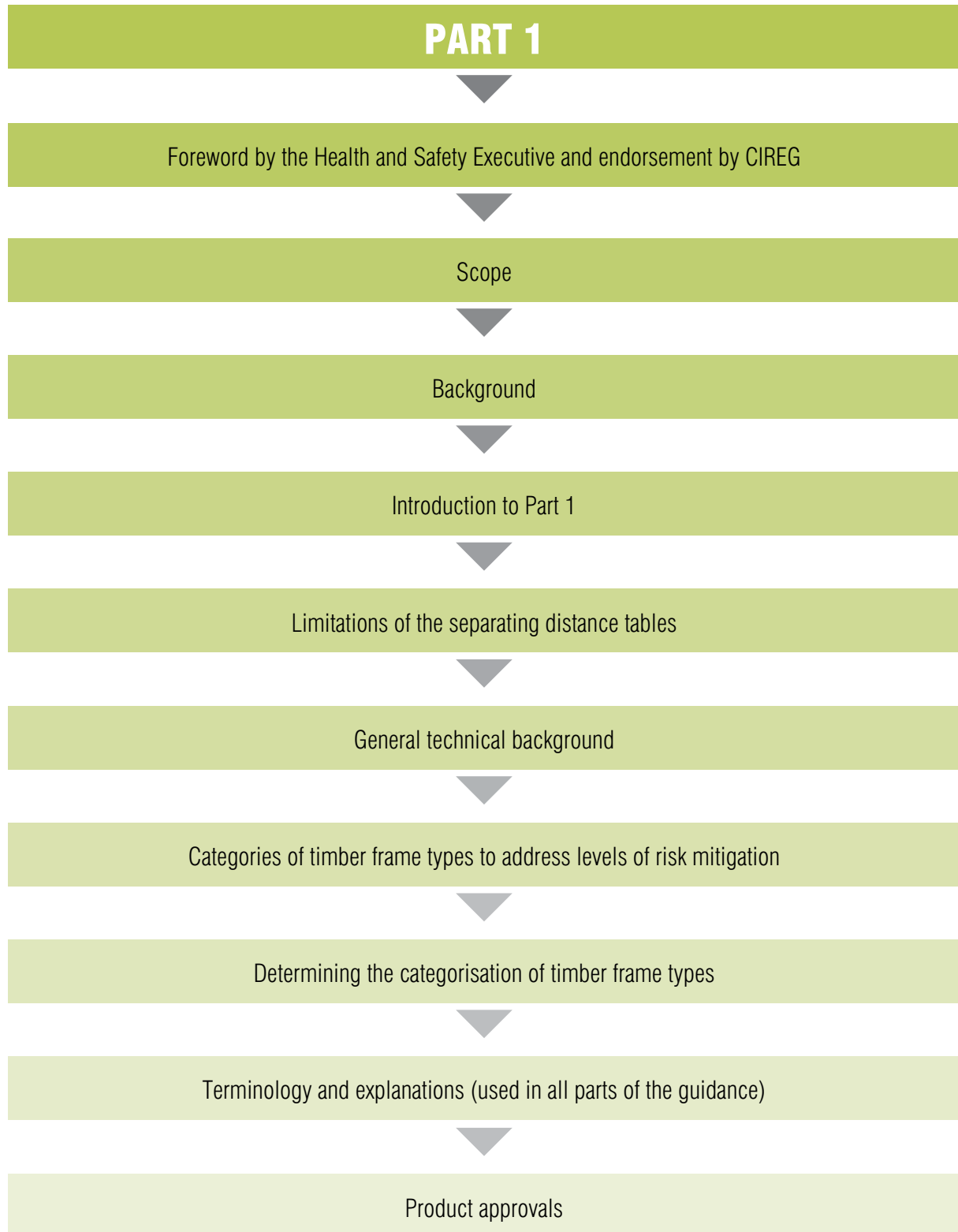
Design guide to separating distances during construction

For timber frame buildings above 600m² total floor area

Version 2.1 - December 2012



Part 1 - Background and introduction



Foreword by the Health and Safety Executive

Fire is a hazard during most construction processes and it is important that precautions are in place to both prevent fires and ensure that people can escape to safety if fire does occur. HSE has published its own guidance on fire in construction. In recent years HSE has been working with the UKTFA to consider the particular issues arising from timber frame construction. Finished timber frame structures meet strict fire protection requirements. However, during the construction phase, they are more vulnerable because the precautions for the finished building are not in place. There have been a number of large and serious fires involving timber frames during construction which have affected neighbouring properties, thankfully without loss of life. Such fires have demonstrated the need for clients to consider carefully neighbouring properties and activities very early in the design process in line with their duties under the Construction (Design and Management) Regulations 2007. The first revision of this UKTFA document builds on further scientific work undertaken by the industry to understand fire behaviour in such structures, and on the experience of the industry applying the original guidance. This guidance allows a sensible assessment to be made of specific proposals and sites at the earliest design stages to ensure that effective precautions can be taken to protect all stages of construction. HSE will continue to work with UKTFA on this issue but in the meantime commends this guidance to the industry.

Philip White
Chief Inspector of Construction
Health and Safety Executive
November 2012

Endorsement of the UKTFA Design Guide to Separating Distances by CIREG

We are pleased to endorse the 'Design Guide to Separating Distances during Construction for Timber Frame Buildings above 600m² total floor area (Version 2, December 2012)', produced by the UK Timber Frame Association (UKTFA), as Best Practice for managing fire risk during timber frame construction.

We also commend the UKTFA for its efforts to improve fire safety of timber frame buildings during construction.

Ade Adeyemo
Chairman
The Construction Insurance Risk Engineers Group
December 2012



Scope

This guidance is intended to be used from the design phase of a project. It can also be used during the procurement stages and pre-start on-site stage.

The use of this document is intended as the basis for the development of an off the site fire risk assessment plan, sufficient to address the requirements of HSG168, that relate to the spread of fire to neighbouring buildings.

Projects covered in this document are developments built near to properties where persons sleep or are areas of public gathering - such as schools, colleges, restaurants, night clubs, office space and light commercial properties such as high street shops and factories. Where a new development is to be built near to premises that have highly combustible materials stored, a competent fire engineer must be engaged to review the fire risk assessment.

The guidance is aimed at the commercial construction market for example, classrooms, multiple terrace houses, flats or rooms for sleeping purposes. It is not applicable to the one off house market or small developments. The document has been written with a focus on timber frame buildings that are above 600m² of total floor area.

The calculations in this guidance complement the practical advice provided by the UKTFA 16 Steps to Fire Safety (see www.uktfa.com for a free download of the 16 Steps guidance).

It is anticipated that project designers, architects, CDM co-ordinators, project managers, timber frame companies, builders, HSE inspectors, insurance inspectors and product suppliers will all find this guidance of use.

Background

HSG168 "Fire Safety in Construction" published by the Health and Safety Executive (HSE) in October 2010, requires a site specific risk assessment to be undertaken to determine the impact of a site fire on neighbouring properties. As no accepted methodology existed for such an assessment on timber frame sites, the UKTFA undertook the task of preparing authoritative guidance in co-operation with a timber frame working party including the HSE, the Fire Protection Association (FPA), the Chief Fire Officers Association (CFOA) and the Fire Brigade Union (FBU).

The guidance within this document is the result of extensive fire testing and expert input from the fire engineering community. The Association wishes to acknowledge the co-operation and significant input of the HSE and HSL along with FERMI, fire engineering consultants, and Martin Milner, UKTFA Technical Consultant in the preparation of this guidance.

In December 2011 the first edition of this guidance was issued. This is an updated version of the guidance which includes the research findings of an extensive test programme undertaken by the industry during the spring of 2012.

'Design guide to separating distances for timber frame buildings during construction' has a number of parts as follows:

| | |
|---------------|---|
| 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 |

The UKTFA have developed supporting documents for the timber supply chain, product designers, fire engineers and fire test facilities. They provide background technical data and support the delivery of the solutions presented in this guidance. These supporting documents are available on the UKTFA website www.uktfa.com.

Supporting documents - technical support:

| | |
|--------------------------|---|
| 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 |

Supporting documents - product 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 |
| Product Paper 4 | Product assemblies to achieve different categories of timber frame construction - <i>results from 2012 research programme</i> |

The flow chart shown in figure 1.1 below illustrates the use of the various UKTFA documents that exist under the UKTFA Site Safe strategy in conjunction with the RIBA work stages.

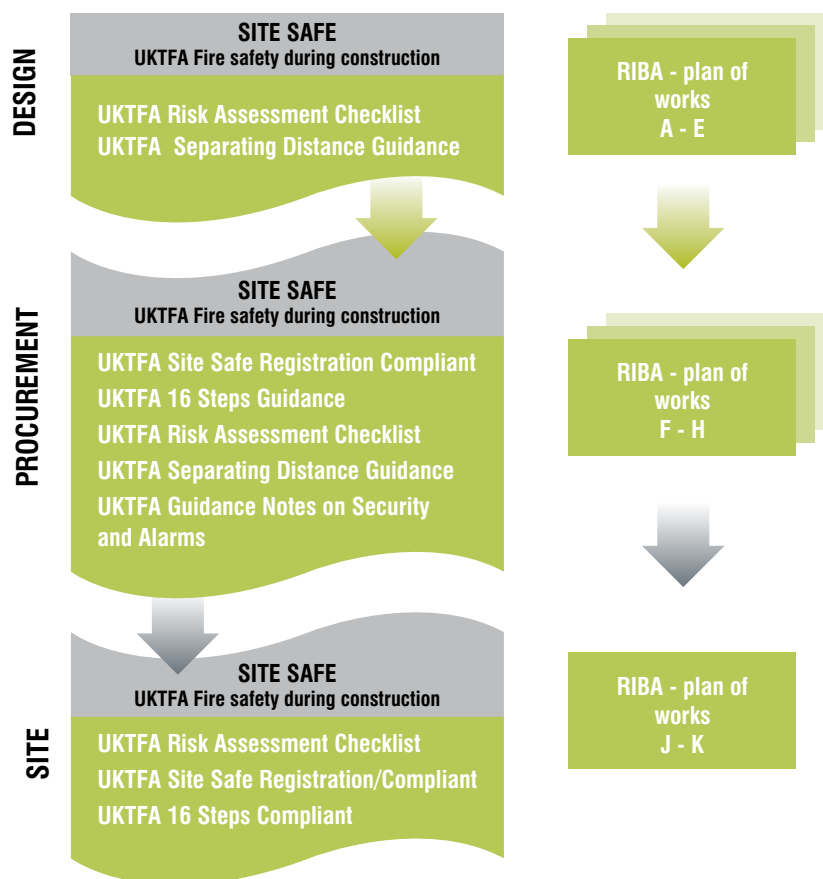


Figure 1.1 UKTFA Site Safe strategy documents and point of application

Introduction to Part 1

This guidance provides a consistent, appropriately conservative, methodology to assess the fire risk to neighbouring buildings should a fire occur in a timber frame building during construction.

Finished timber frame structures are fully compliant with Building Regulation fire performance and as such the assessment is confined to the period during construction prior to completion of fire resistant finishes.

This guidance is part of the UK Timber Frame Association's Site Safe strategy and should be used in conjunction with the other UKTFA guidance documents as noted in Figure 1.1. The technical data in this guide is based on a conservative calculation model backed by test data to determine the exposure of neighbouring buildings to heat radiation during a site fire event. To keep the assessment process straightforward there are a number of underlying assumptions and simplifications. As an alternative to this guidance, a more precise assessment by a competent fire engineer can be undertaken. Technical Paper 1 and Paper 2 give information that will enable fire engineers to provide these assessments on a consistent basis.

Three generic categories of timber frame with increasing resistance to fire spread and associated reduction in radiant heat to neighbouring properties are presented. The guidance is based on the range of buildings as given in the scope. The three categories of timber frame allow the designer to select the appropriate frame specification to construct timber frame buildings on any site condition, relating to separating distances from 0 to infinity. The output from this process is intended to form the basis of the site fire safety risk assessment which will also include preventative measures as recommended in the UKTFA Site Safe and 16 Steps guidance.

Limitations of the separating distance tables

Separating distance tables provided in parts 2 and 3 assume that the neighbouring buildings contain combustible elements such as eaves or soffits which can be ignited and / or windows through which the contents of a room can receive radiant heat. Should the neighbouring building not contain ignitable materials or windows then a competent fire engineer could be engaged to reduce the separating distance. Where neighbouring occupancies are unable to evacuate the building, then a specific risk assessment by a fire engineer is warranted.

Where a neighbouring building use increases the risks beyond the domestic, hotel, student accommodation or school properties assumed by this guidance then a specific risk assessment by a fire engineer is warranted, e.g. chemical storage or external storage of unprotected flammable materials.

The guidance is focused on neighbouring buildings off the site (beyond the current construction site boundary - refer to the terminology section). For buildings within the site boundary, the guidance can be used to support determination of safe escape distances and fire spread across a site. Sites utilising a tower crane should carry out a specific assessment covering the evacuation of the driver and possible impact of fire on crane stability.

It is the principal contractor's responsibility to ensure that the fire precautions and recommendations are undertaken on-site. This guidance allows the project team to adopt the appropriate frame specification and/or construction process methods to mitigate fire risks; and permits designers to discharge their responsibilities under the CDM regulations by having the assurance that frame specifications can be selected for different site conditions without necessarily engaging external expertise. The UK Timber Frame Association accepts no liability regarding the occurrence of fire or associated damage to property either on or off the site following the use of this guidance. Every site is unique and the preparation of appropriate risk assessments and the effective implementation of appropriate mitigation measures lie outside the Association's control.

General technical background

The purpose of the design guide is to reduce radiant heat emissions to acceptable levels; so that the risk of fire spread to neighbouring buildings is appropriately controlled in the event that a fire occurs during the construction process.

Where the available separation distances show that additional measures are required, a hierarchical approach should be adopted. As with all risk mitigation, minimising the underlying risk at source is preferred. Within this guidance the off the site fire risks are reduced, when necessary, by the use of frame/deck designs which reduce the potential for fire to develop and spread.

This guidance enables the designer to specify a type of timber frame system which may have inherent mitigation measures (i.e. Category B and C frames) or, where suitable, by adapting the construction process to allow the use of standard Category A frame.

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

1 The use of the neighbouring building

The factors affecting a typical fire risk assessment include consideration of:

- a Occupant Type - mobility of occupants, exit routes, risk of a fire during the night whilst occupants are sleeping and the experience of occupants to a fire warning.
- b Building usage - domestic, factory, storage and dangerous substances/usage.
- c A building under construction near to the building being assessed.

This guidance is based on the assumption that occupants may stay overnight in the neighbouring building which is referred to as "sleeping risks". It is also assumed that evacuation can be reasonably achieved and that there are no additional extreme risks such as the presence of volatile liquids or explosives. The guidance is focused on neighbouring buildings off the site - that is beyond the current construction site boundary. Assessment of buildings on a site should be assessed using UKTFA 16 Steps. Issues relating to radiant heat flux separating distances will be needed only for checking fire spread across a site, which would endanger a neighbouring building or reduce escape distances for the on-site labour.

2 The facade of the neighbouring building

The facade of the building being considered can also influence the risk of fire spread. The guidance tables assume that the facade includes combustible materials such as timber soffits and PVCu window frames (risk of melting). In addition where windows are present, the threshold level of radiant heat values is limited to prevent the risk of radiant heat igniting contents of a room such as curtains.

Where totally non-combustible facades are present without openings then the tables will be overly conservative and will not be appropriate.

3 The site conditions and wind

The assessment of wind influence on fires is very complex and this guidance reasonably accounts for the effects of wind by adopting a conservative level of radiant heat on a receiver surface.

4 The site terrain

The potential influence of site vegetation, including trees, is not considered in the tables. Where such influence is considered significant, suitable mitigation measures will need to be adopted.

5 Site operations

The fire risk assessment should consider the influence of site processes on fire risk as recommended in the UKTFA 16 Steps and the Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation (published by the FPA, Current Edition 8). This would include the location of parked vehicles, any fuel/gas bottle storage, material stored before use, waste skips and the like. The information presented in this guidance assumes that site operations are compliant with these recommendations.

6 The growth of fire

The maximum radiant heat generated is dependent on the speed of fire development across a building, the emitter temperature and the extent of fire spread within the structure. This guidance is supported by test evidence on the timber frame categories (see later section on frame categories) where development time, extent of fire spread and heat flux output were measured.

The growth of a fire will be dependent on many factors including building layout, stage and condition of the frame installation, and the presence or absence of fire breaks. In developing the tables an appropriately conservative approach was used to arrive at predictions of fire behaviour up through a building and across internal walls. A summary of the fire growth assumptions is given in Technical Papers 1 and 2.

7 The acceptable threshold level of radiant heat on a given surface

The acceptable radiant heat flux on a surface is taken as 12.6kW/m² over a ten minute period as the threshold for acceptance on a façade containing combustible material. It is accepted that this level of radiant heat is sufficient for exposed dry timbers with a pilot ignition (from flying brands etc.) to ignite under laboratory conditions and we acknowledge that it may be considered by some fire engineers to be overly conservative. However, in view of the unpredictable nature of fire growth in real buildings the figure is considered appropriate by the HSE for the purposes of assessment under HSG168.

8 Building size

The tables are based on a standardised nominal storey height of 3m. It is very unusual for buildings to depart significantly from this floor to floor dimension.

For the purposes of simplicity the tables also take the worst case of either a 1m high parapet wall around the roof or a pitched roof which is equal to or less than 55 degrees. Significant variance from these parameters may require a specific assessment by a fire engineer.

Categories of timber frame types to address levels of risk mitigation

The tables are based on three principle calculation models that predict different fire behaviour, which in turn, indicates what the expected radiant heat output from such a fire would be. For timber frames to comply with the model's predicted behaviour there is a category of structural timber frame assembly that delivers the performance characteristics to match the calculation approach. The guidance provides the categories of timber frame with increasing resistance to fire spread and reducing radiant heat emissions.

Category A - Standard open panel timber frame

Category B - Reduced fire spread timber frame

Category C - Fire spread resistant timber frame

Contrary to common fire rating terminology and testing practice, the information presented in this guidance is based on holistic testing of building structures rather than component parts or materials. As such the guidance is relevant for the whole construction process from commencement to handover. A standard test method has been developed by the UKTFA in conjunction with the timber frame working group and accepted by the advisory working group. Technical Paper 3 outlines the test methodology which will be used for future development work on this guide.

Determining the categorisation of timber frame types

The tables presented are based on a mathematical model that has been backed by scale tests. It is impractical to undertake multiple full scale tests of houses and apartment buildings, so the UKTFA has conducted a series of room scale tests of structures up to 2 storeys, recording fire characteristics such as flame height, temperature and radiant heat flux. The results of these tests were compared against theoretical models and experience from real fires and found to be sufficiently representative of real site performance to enable the results from them to be used in the preparation of this guidance. In addition, ignition tests and small room tests have been developed and benchmarked against the larger scale tests to provide a repeatable test method to determine where a particular framing system could be classified under each of the three categories. The UKTFA is developing third party certification processes to support future system innovation. Technical Papers 1 to 3 provide information on the tests and the frame categories. Supporting papers on product compliance (Product Papers 1 - 3) outline the required product specification to be used in compliant timber frame construction.

The UKTFA has established a test and approval protocol for systems and product assemblies that has undergone the methodology described in Technical Paper 3. The list of products that have been reviewed for compliance to tests are available from the UKTFA website. No products or components can be claimed to satisfy in full or in part the requirements of Category B or C until they are listed on the website. Product Paper 4, which is developed by the UKTFA, is provided to assist the timber frame designers and fire engineers to deliver Category B or C type solutions.

Terminology and explanations (used in all parts of the guidance)

Any fire mitigation method which is not described in this guidance should be designed and justified by a fire specialist.

Emitter

The building being constructed and where the fire can be initiated. The length of the emitter facing the receiver is used in the guidance.

Fire shield / Fire curtain

Fire Shields are outside the scope of this guidance. Any risk mitigation strategy which considers fire shields shall have the approval of a fire engineer and structural engineer to consider the impact of support to the shield during a fire.

Fire curtain material is not included in the scope of this document and the HSE will require application testing together with a fire engineers report for any consideration of a fire curtain to be used as a risk mitigation measure.

Fire compartmentation

In the context of the building during construction the term fire compartmentation is used for vertical walls or horizontal decks installed as the building is erected and constructed so that they to act as a barrier to the spread of fire.

Vertical fire compartmentation may be required in Category B and C frames to limit the spread of fire across the building, reducing the maximum emitter length. These walls extend from the lowest timber frame level to the roof ridge line and have no unprotected openings in them. The requirements for fire compartmentation walls are described in Figure 3.2 in Part 3 of the guidance.

For Category C construction, vertical fire spread also needs to be controlled. The fire compartmentation preventing vertical fire spread through the floor is provided by floor assemblies that have passed the Category C criteria (given in Technical Paper 2) in the room test described in Technical Paper 3. A generic floor requirement for Category B and C is provided in Figure 3.2 in Part 3.

Fire doors

A self-closing fire door provides access through a fire compartment with a fire performance at least equal to the fire resistant wall of which it is a part.

Guidance tables

Minimum separation distances for a given emitter length approximately parallel to the receiver face (within 15°). For non-parallel conditions (more than 15°) see relevant section in Part 2 and Part 3 of the guidance.

Non-combustible boards and boards of limited combustibility

Boards that can be classified as such based on testing to EN standards, Euro class A1 and A2.

Receiver

Any surface of a structure, element or part of building that can be subject to radiant heat flux.

Separating distance

The distance between a receiver and emitter. This is to be taken as the nearest point between the two buildings (see below).

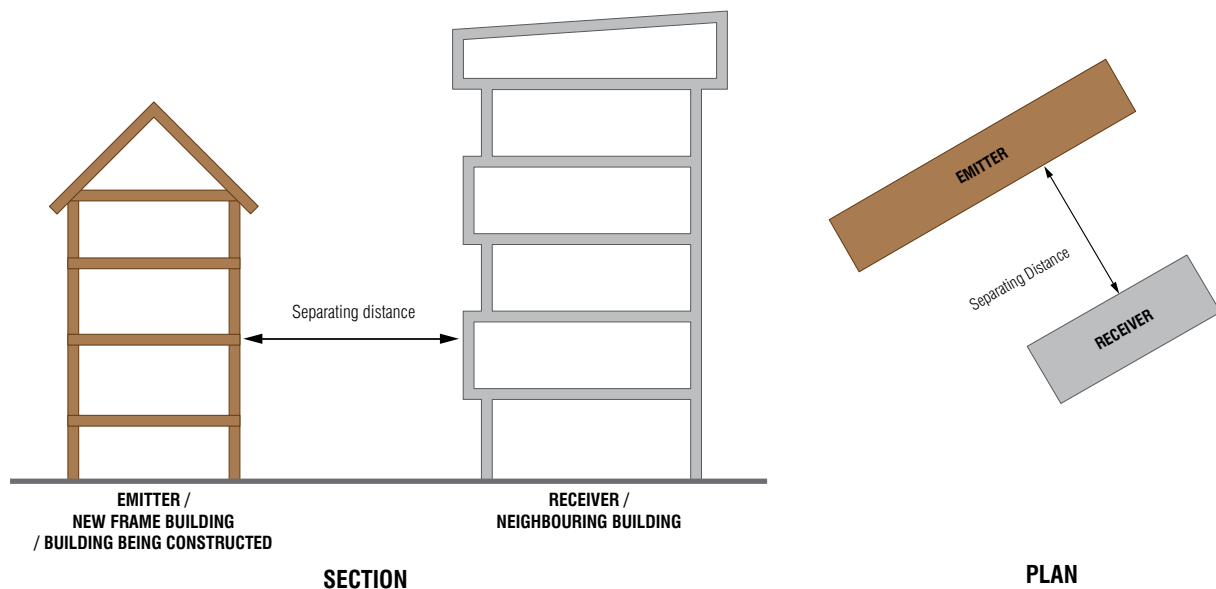


Figure 1.2 The separating distance is the nearest point between the emitter and receiver

Timber frame category

The tables are based on three model calculations that are based on an assumed spread of fire in an incomplete building of a specific type of timber frame construction; which are called categories of timber frame A, B or C. Each category of timber frame has a predetermined performance when exposed to a developed fire which has been derived by tests and assessments of real fires. The timber frame assembly corresponding to that fire behaviour is represented by the following:

Category A - Standard open panel timber frame

Category B - Reduced fire spread timber frame

Category C - Fire spread resistant timber frame

Category B frames are subdivided into 3 types - B1, B2 and B3 with increasing fire resistance matched to the calculation model that represents the type B fire behaviour.

Category C frames are subdivided into 2 types C1 and C2 with increasing fire resistance matched to the calculation model that represents the type C fire behaviour.

On-site and off the site definitions

The term off the site risk assessment is used to describe land and buildings beyond the site boundary that are out of the principal contractors control. The term on-site risk assessment is used to describe land and buildings, typically within the site boundary fencing, for which the principal contractor is responsible.

Note: Where a development programme includes the phased handover of buildings to occupants and used by persons not under the control of the principal contractor these buildings will be considered as off the site once they have been handed over.

The preparation of on-site risk assessments for separating distances between buildings is the responsibility of the principal contractor. Assessment of multiple buildings is to be undertaken to check that the site's build programme does not create conditions that can cause a fire to spread between the units, resulting in the adjacent new build timber frame adding to the original fire and increasing the amount of radiant heat that off the site risks may be exposed to.

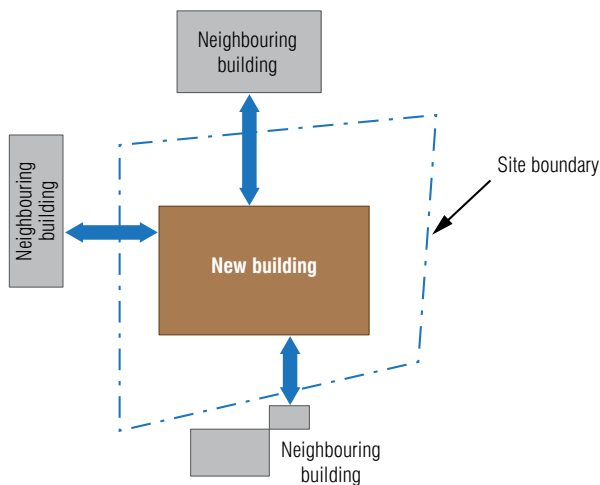
It is the responsibility of the principal contractor to ensure that the means of escape and travel distances are appropriate. Guidance on this is provided in the UKTFA 16 Steps publication.

The principal contractor may need to provide protection to the means of escape. The separating distance guidance contained in this publication can be used to assist the assessment of options for reducing the risk of these conditions.

Figure 1.3 and figure 1.4 present schematic illustrations of two sites where timber framed buildings are under construction. The diagrams show the difference between on-site and off the site separation.

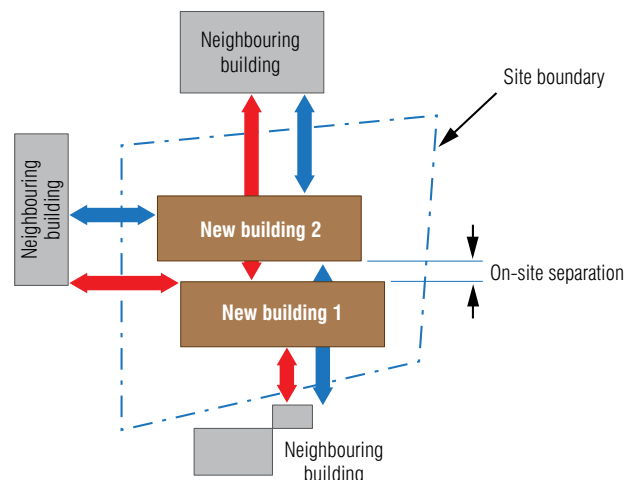
Each new building, depending on the build sequence, requires its own risk assessment of the off the site separating distance. Once one of the new buildings is in place it can provide a shield to the neighbouring building if its elevation is non combustible. Alternatively, each new build could provide a link to spread the fire and in turn require the separating distance to be calculated per new block or as a combined width depending on which elevation is being considered - see Part 2 for further explanation.

Figure 1.3



KEY
 Off the site distance

Figure 1.4



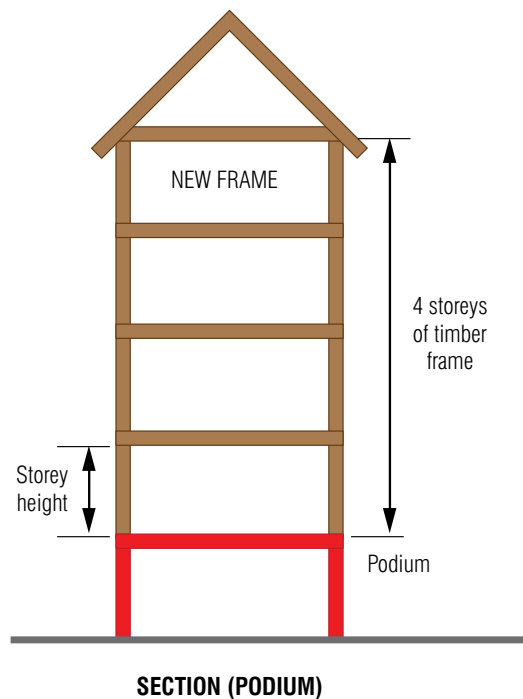
KEY
 Off the site distance building 1
 Off the site distance building 2

Podium and higher ground levels

The podium is taken as a non-combustible element of structure, e.g. a concrete structure and/or a steel structure with infill walls and non combustible floors, however the floor can be a timber floor as in flats above garage structures (FR Build treatments dependent on the frame category selected).

Where a podium or higher ground levels are adopted then the actual number of timber frame storeys should be used in calculating the separating distance.

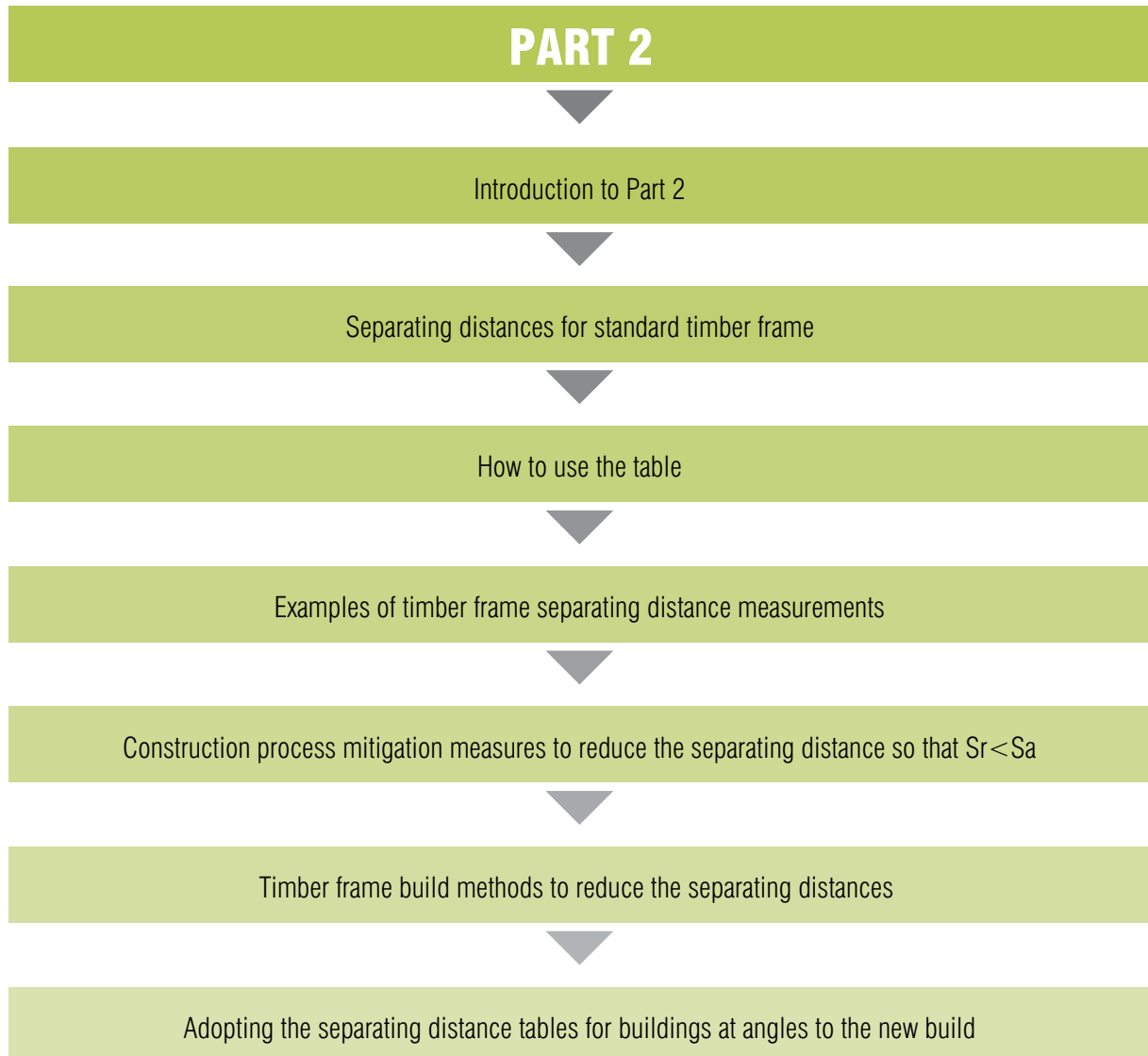
The podium level structure is omitted from the timber frame height providing the walls and floor of the podium is non-combustible or the external walls are Category B or C compliant timber frame.



Product UKTFA website listing

All products listed on the UKTFA website have been tested using the methodology described in Technical Paper 3 and their test performance has been reviewed by the Approval Committee of the UKTFA. No products, components or systems can be claimed to satisfy in full or in part the requirements of Category B (B1, B2, B3) or C until they are listed on the website.

Part 2 - Standard timber frame and construction process mitigation methods



Introduction to Part 2

This guidance provides a consistent, appropriately conservative, methodology to assess the fire risk to neighbouring buildings should a fire occur in a timber frame building during construction. Finished timber frame structures are fully compliant with Building Regulation fire performance and as such the assessment is confined to the period during construction prior to completion of fire resistant finishes.

Part 1 of the Design Guide provides the scope, background and introduction to the separating distance tables. Part 2 of the guidance provides information on the use of the separating distance tables with a specific focus on standard timber frame and construction process mitigation measures. Where assessment shows that the separating distances for standard timber frame cannot be met, the designer can adopt timber frame build methods to reduce the separating distances, which is presented in Part 3.

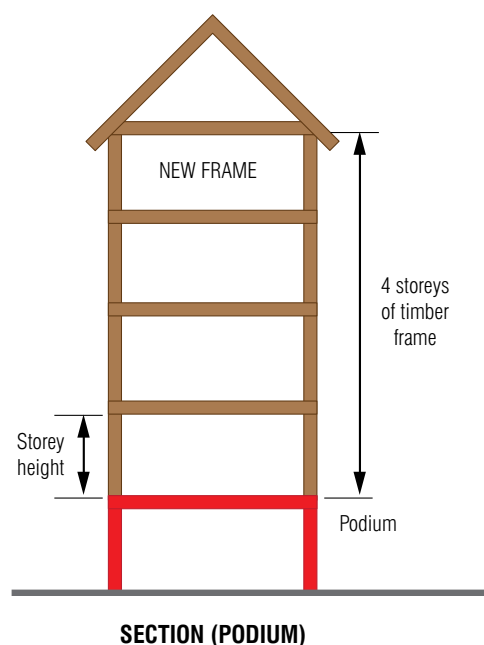
Separating distances for standard timber frame (Category A)

Table 1 for Category A - Timber frame separating distance (Sr) in metres

| 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 |

Notes:

- 1 The data in this table applies to projects with a total floor area greater than 600m². See 'Scope' in Part 1.
- 2 The data in this table is based on a nominal storey height of 3m.
- 3 The receiver height does influence the radiant heat on the surface of the building but for simplicity this aspect is removed from the table and assumes that the receiver is 3 or more storeys in height. No reduction is given for lower receiver heights.
- 4 Should a podium or higher ground levels be adopted then the actual number of storey levels of timber frame is used in the table.



See part 1 for further explanation of podium structures

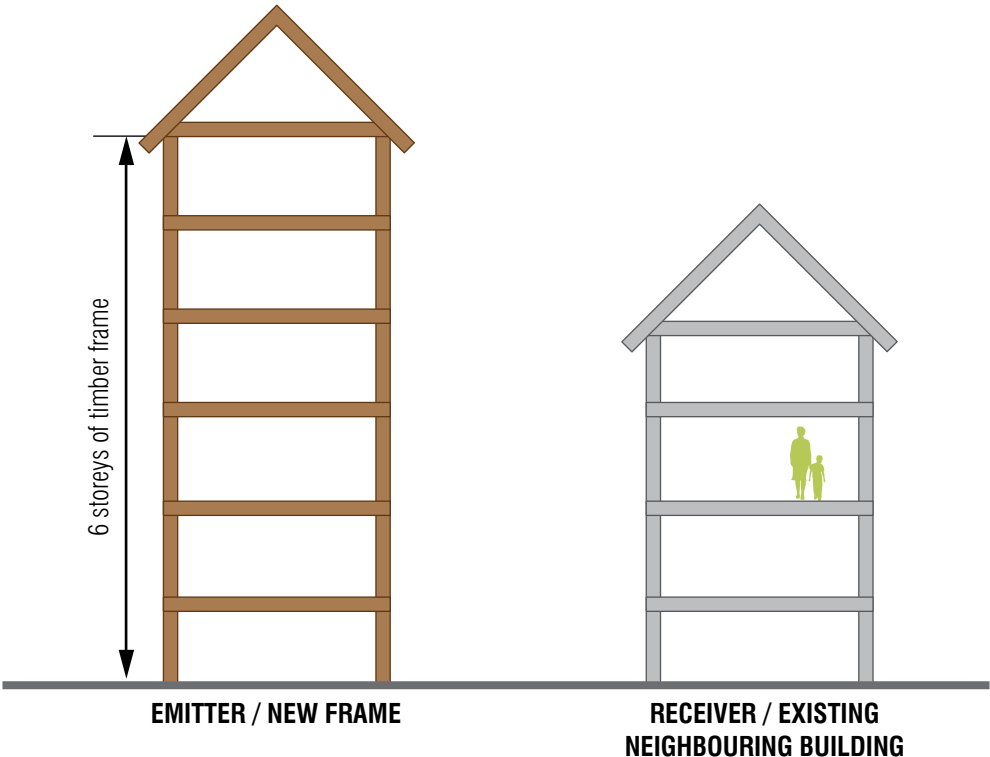
Figure 2.1 Example of storey heights and approach using podiums

How to use the table for standard timber frame

Step 1: Identify the overall height of emitter

Determine the number of storeys of the emitter building.

**Example Step 1 (a)
6 storey emitter**



**Example Step 1 (b)
2 storey podium - gives 2 storey emitter**

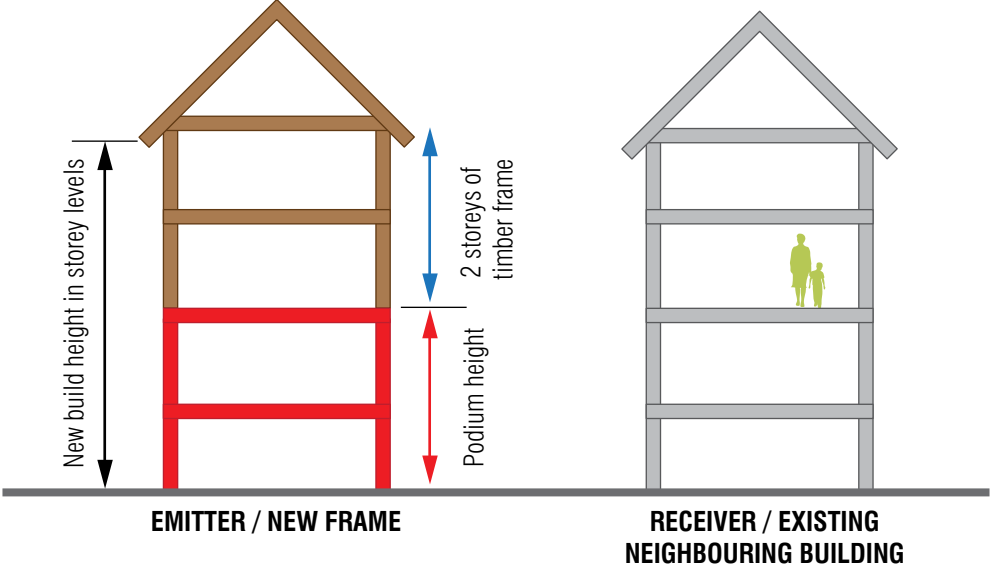


Figure 2.2 Storey height of emitter

Step 2: Emitter length (eL)

On the face being considered measure the length of the emitter: called emitter length (eL). Note: The length is the face of the emitter opposite the receiver.

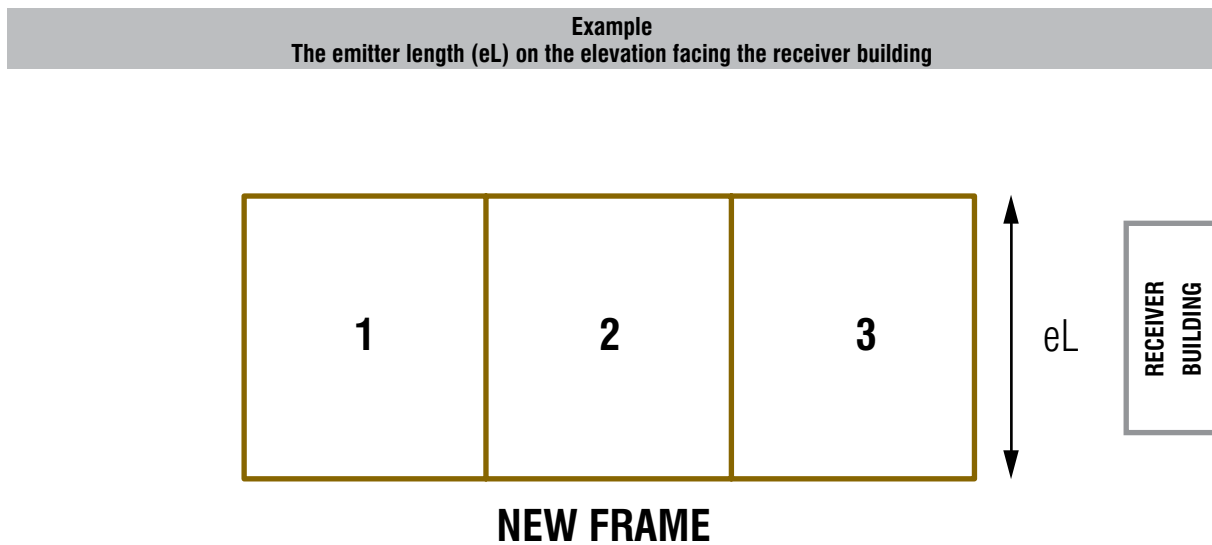
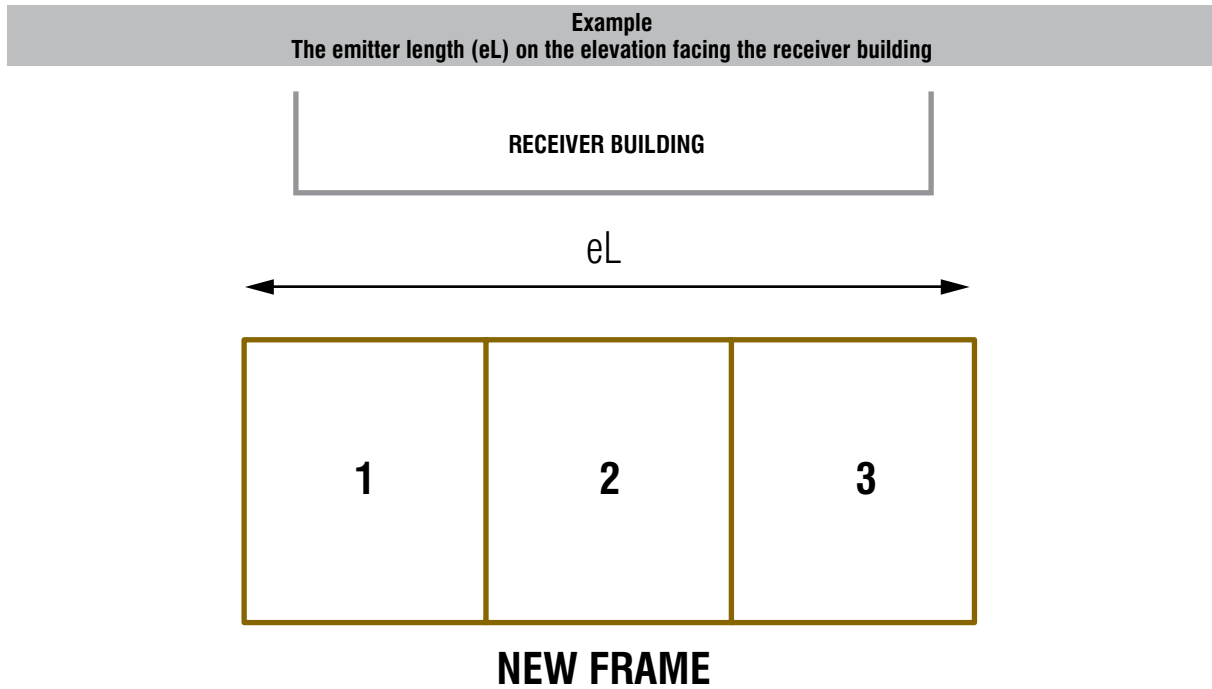


Figure 2.3 Emitter lengths

Step 3: Separating distance (S_r) from table

Using the table, select the separating distance relevant to the emitter length and number of timber frame storeys.

For example, a project with no podium, for a 3 storey timber frame, with length (eL) of 14m the separating distance (S_r) = 16m as read from the Category A table.

Table 1 for Category A - Timber frame separating distance (S_r)(m)

| Number of timber frame storeys | EMITTER LENGTH (eL) | | | | | | |
|--------------------------------|-------------------------|------------|------------|------------|------------|------------|---------|
| | $\leq 5m$ | $\leq 10m$ | $\leq 15m$ | $\leq 20m$ | $\leq 25m$ | $\leq 40m$ | $> 40m$ |
| 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 |

Step 4: Determine if the actual distance (S_a) is satisfactory

The separating distance (S_r) derived from the table is checked against the actual distance (S_a) between the emitter and receiver. This can be done diagrammatically by drawing a rectangle (S_r) deep by (eL) long. If the rectangle overlaps the receiver at any point; then fire risk mitigation measures will be required. Guidance on construction process fire risk mitigation measures is provided in this document.

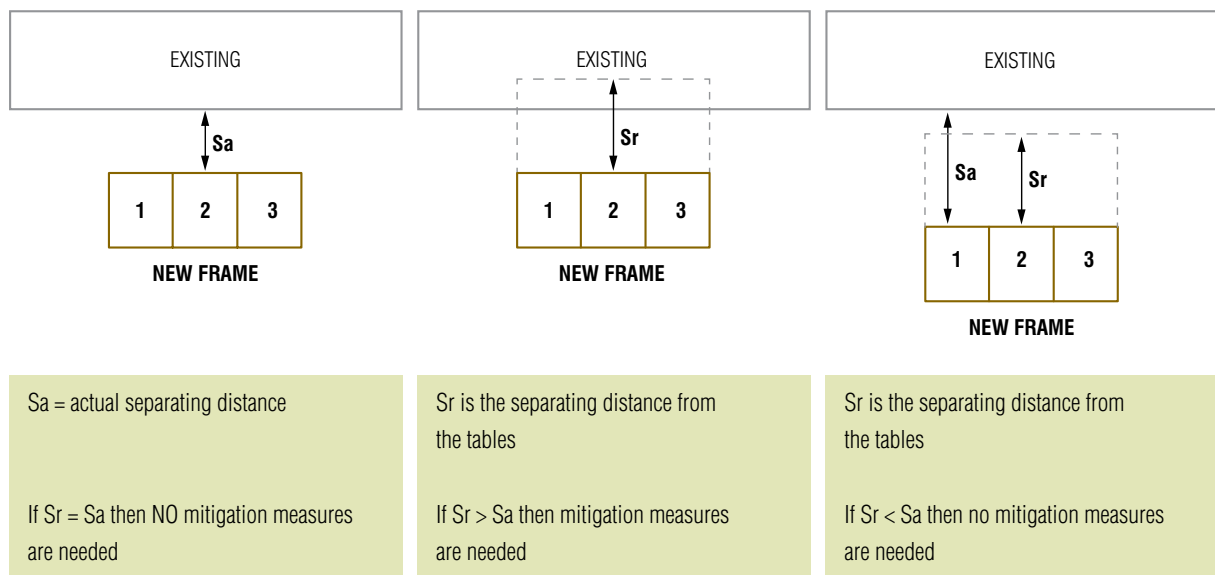


Figure 2.4 Comparing required distances to actual distances between buildings (Plan view)

Example of timber frame separating distance measurements

Project Example

A six storey residential building comprises five storeys of timber frame on single storey concrete podium. The building has an elevation length of 45m. The new building's front elevation is 17.5m away from an existing building. What is the separation distance for a Category A frame?

| | No. of Timber frame storeys | Actual distance Sa between Emitter and Receiver | Emitter Length eL |
|---------------------------------------|-----------------------------|---|-------------------|
| Emitter (timber frame element) | 5 | 17.5m | 45m |

Note the height of the receiver building is not required for the calculations

Table 1 for Category A - Timber frame separating distance (Sr) in metres

| 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 |

$S_r (= 41.75m) > S_a (=17.50m)$ therefore, a construction process risk mitigation is required for a Category A frame. Consider Category B and C frame options as a priority within a hierarchy risk management approach.

Construction process mitigation measures to reduce the separating distance (so that $S_r < S_a$)

By reducing the emitter length or number of storeys by risk mitigation measures the calculated S_r may be reduced so that $S_r < S_a$. Consider the following:

- a Adopt a more fire resistant timber frame specification (Refer to Part 3).
- b Changing the emitter footprint and / or orientation to avoid risk mitigation requirements.
- c The use of build process to construct the final and permanent building outer cladding - assuming this is building regulation fire compliant for the building, as the timber frame progresses. This has the effect of reducing the frame emitter height used in Table 1 providing the height of the timber frame above the cladding is never exceeded beyond what is calculated as the risk mitigation measure. The designer is to ensure that the cladding is robustly supported so not to collapse prematurely under a fire condition. Consultation with a fire engineer may be required for use of this mitigation measure.
- d Adopt non combustible podium structures to reduce the timber frame height.
- e Engage with a competent fire engineer to assess the site in detail - the site conditions, resistance against arson, accidental damage or weather damage - for both internal and external sources of fire and then review options.

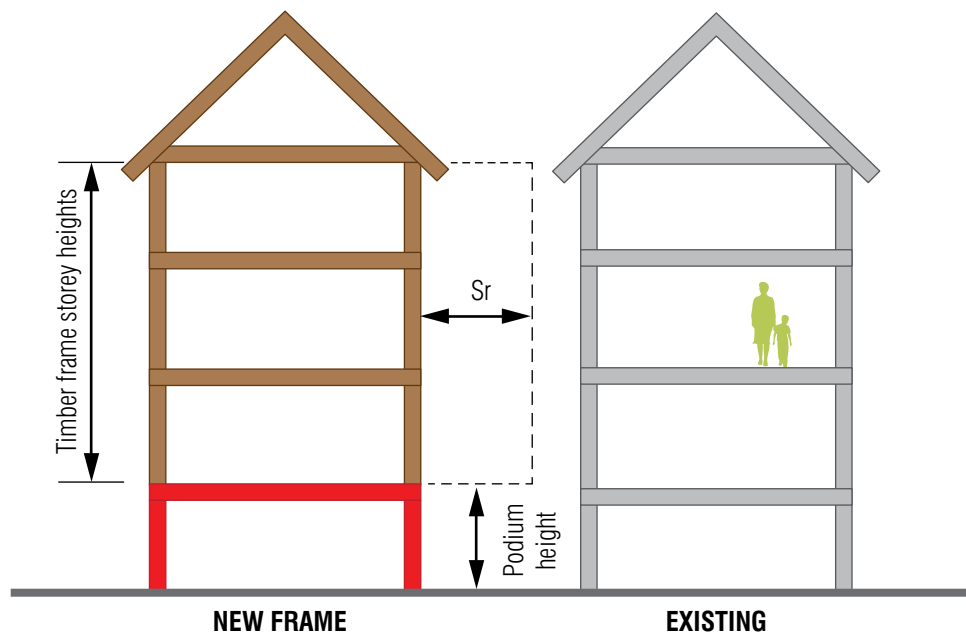


Figure 2.5 How the construction process can be used to reduce the effective storey height

Podium option

The use of a podium structure reduces the effective storey height of the new frame proposed. In this example the emitter height is reduced from 4 to 3 storeys and therefore the separating distance is based on 3 storeys.

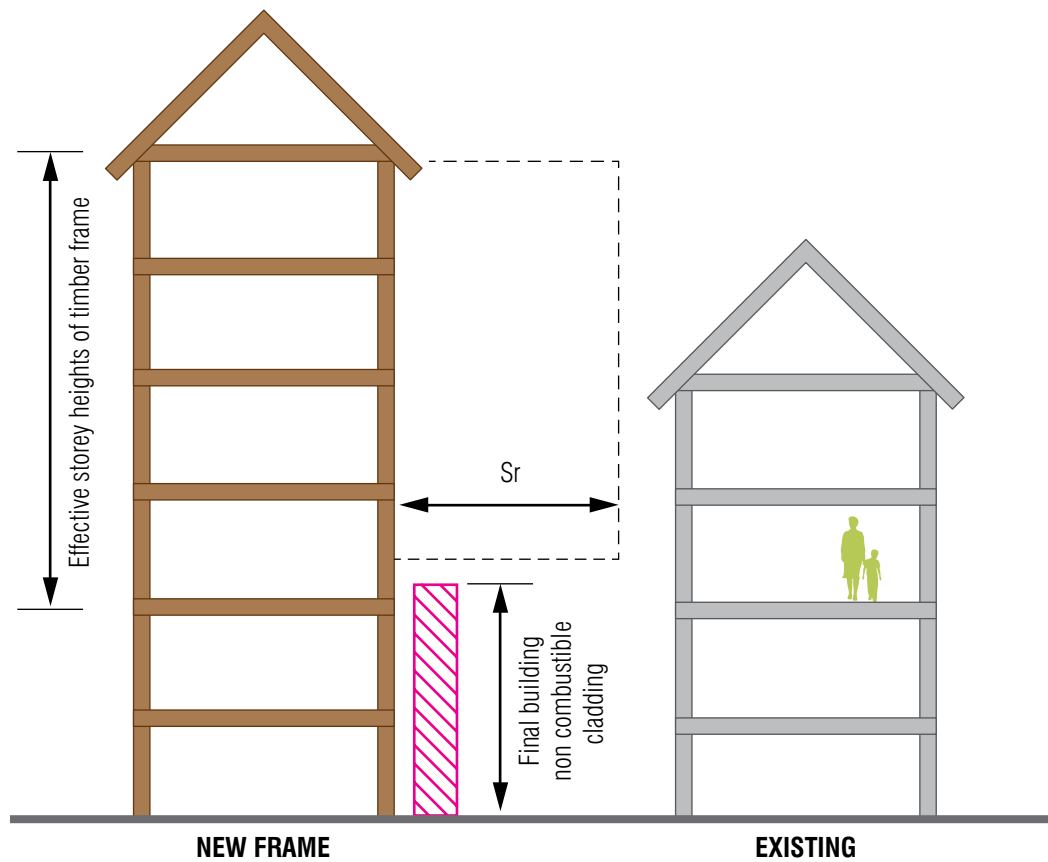


Figure 2.6 Podium and cladding construction options

Final building cladding construction option

Non-combustible cladding (building regulation compliant) attached to the timber frame, built up as the work progresses to reduce the emitter height to ensure S_r is less than S_a . In the example above the 6 storey height new build has been reduced to 4 storey height in terms of determining the separating distance.

The stability of the cladding attached to the Category A timber frame is to be considered, should the timber frame that is supporting the cladding burn away.

Timber frame build methods to reduce the separating distance (Category B and C)

Consider reduction of the separating distance by using Category B or C type frame specifications. Such measures may include pre insulated walls, non-combustible sheathing, Flame Retardant treatment (FR Build) to timbers and sheathing board, or compartmentation within the building may also be appropriate. Note that doors or service penetrations within a fire compartment must have equal or better resistance to fire spread so as not to create a weak link in the wall. Doors should normally be closed.

Part 3 of this guidance provides advice on different methods of timber frame construction to reduce separating distances.

Adopting the separating distance tables for buildings at angles to the new build

The separating distance table on page 19 of this document is based on 'parallel emitters and receivers'. The calculation approach for radiant heat flux is a complex assessment of the relationship between the emitter and receiver. Once the relationship between the emitter and receiver changes to a non-parallel condition the separating distance reduces for most applications. For the purpose of this guidance the separating distance calculation, based on the parallel relationship, is conservative and can be adopted as a guide. A reduced separating distance may result if a competent fire engineer was to assess the project.

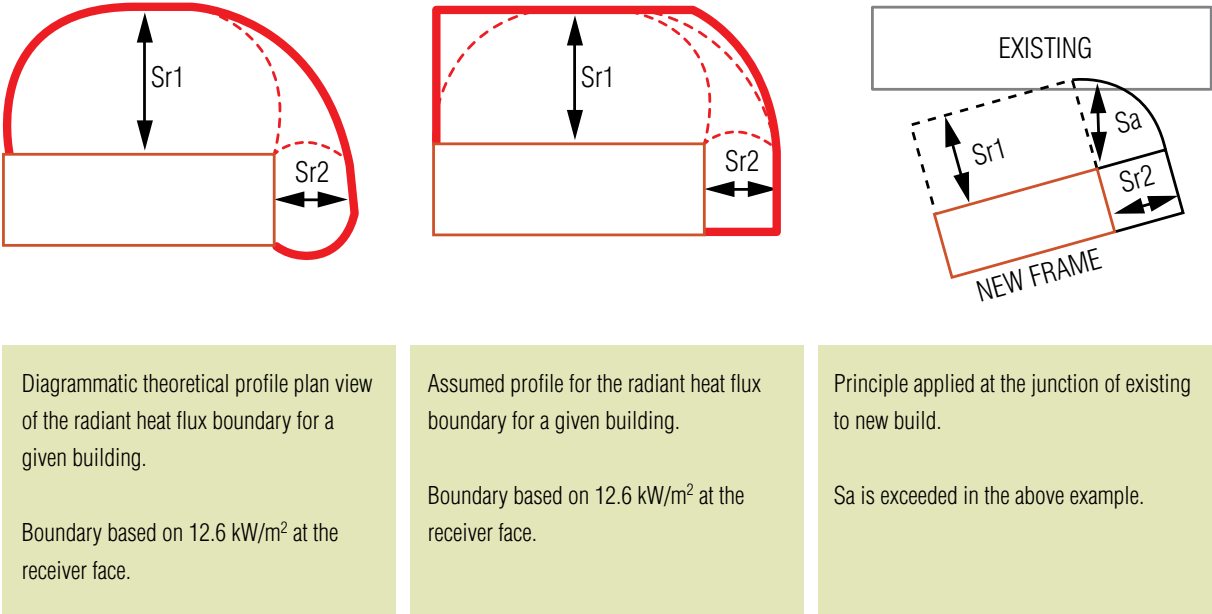
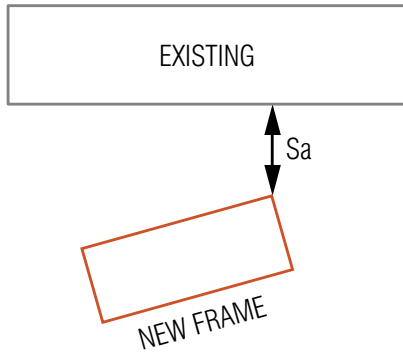


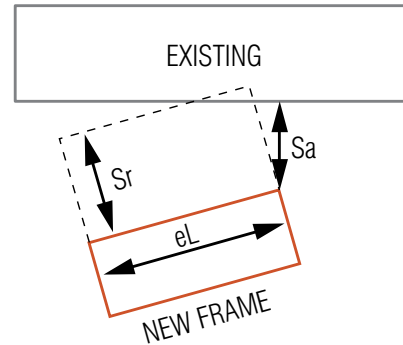
Figure 2.7 Buildings at angles to the emitter

An example of how this applies to the guidance



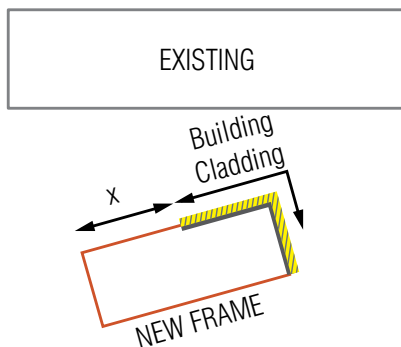
New build at an angle to the existing building.

Figure 2.8a



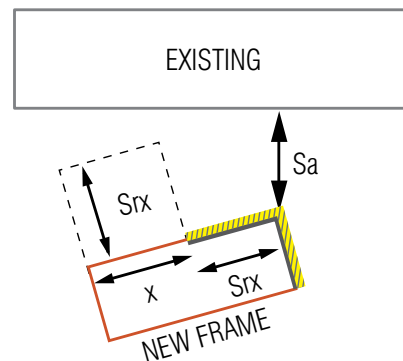
If using the separating tables for a given emitter length (eL) and it is found that the Sr rectangle boundary impinges on the existing building line so that $Sr > Sa$, then mitigation measures are needed.

Figure 2.8b



Mitigation measures to the part of the elevation of the new frame closest to the existing building are required. The existing building can be protected from radiant heat flux by adopting a building regulation compliant cladding strategy to the corner elements. Alternatives for the use of fire shields falls outside of the scope of this guidance. It is pointed out that fire shields are unproven and require assessment by a fire engineer and a structural engineer. They must ensure that the fire growth does not wrap around the fire shield and that the shield itself does not conduct/radiate heat. Structural independent supports will also need to be proven, particularly once subjected to heat from the fire.

Figure 2.8c

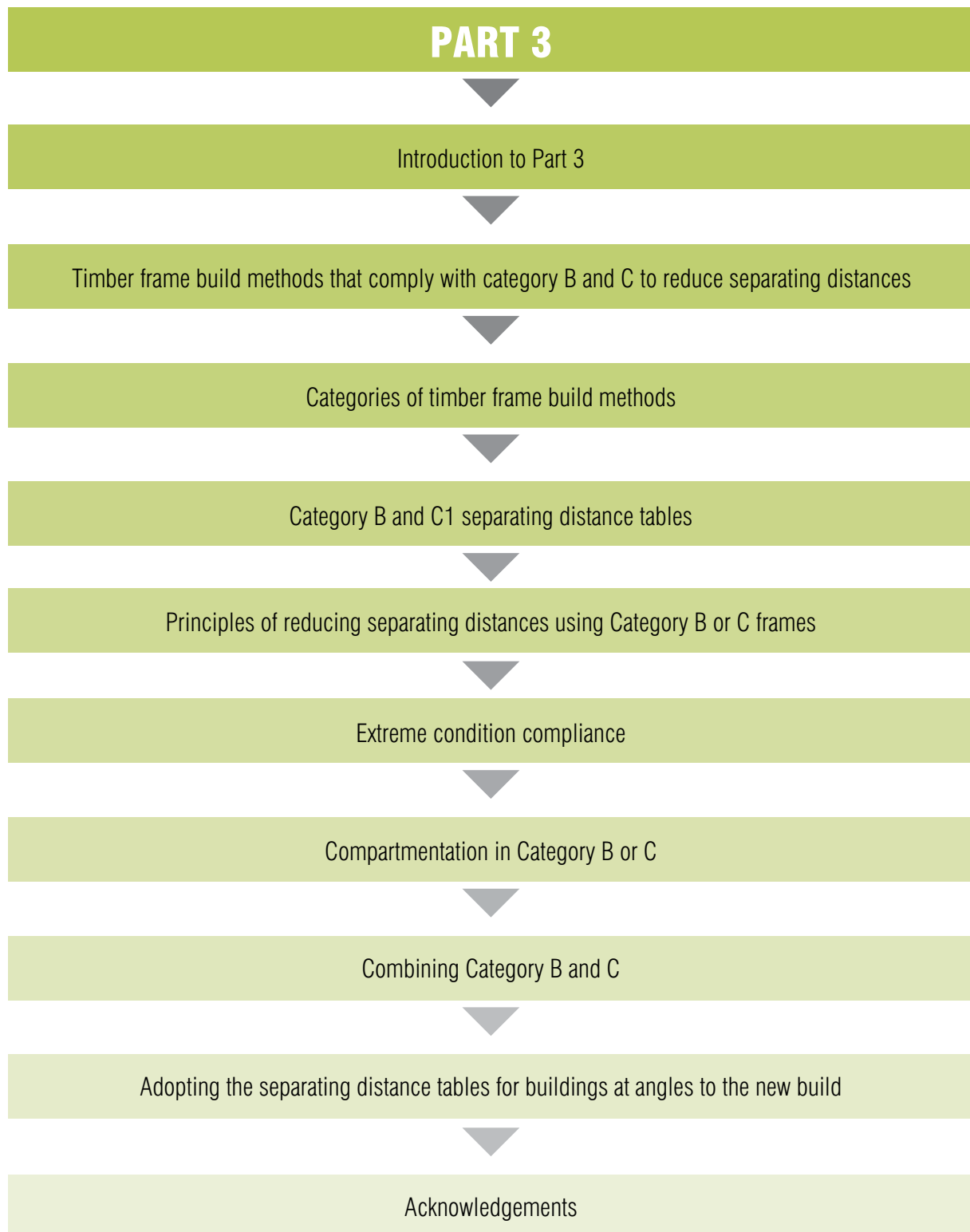


With the cladding in place a revised separating distance for the elevation can be calculated.

In this example the table value of Srx (based on the emitter length x) indicates that no further measures are required.

Figure 2.8d

Part 3 - Timber frame build methods to reduce the separating distances



Introduction to Part 3

Part 1 of the Design Guide provides the scope, background and introduction to the separating distance tables. Part 2 of the guidance provides information on the use of the separating distance tables with a specific focus on standard timber frame and construction process mitigation measures. Where assessment shows that the separating distances for standard timber frame cannot be met, the designer can adopt timber frame build methods to reduce the separating distances. This section of the Design Guide outlines alternative timber frame build methods that can be adopted to reduce the separating distances.

The UKTFA has created 3 categories of timber frame which can be selected to meet the separating distances required. The following table compares the generic performance characteristics of each category used in this guide. Category A timber frame separating distances are dealt with in Part 2 of this guidance.



| Standard Timber Frame | Reduced Fire Spread Timber Frame | Fire Spread Resistant Timber Frame |
|--|---|---------------------------------------|
| Category A | Category B | Category C |
| Separating Distance Guidance Part 2 | Separating Distance Guidance Part 3 | |
| Standard radiant heat emissions | Reduction in radiant heat emissions  | |
| Standard ignition | Reduction potential for ignition of the frame  | |
| Standard growth of fire through compartments | Slower growth of fire spread through compartment | Limited fire growth from seat of fire |

Figure 3.1 Comparison of timber frame categories

Note: In developing the tables Category B is subdivided into three, B1, B2 and B3 with B3 being the best performing, and Category C is subdivided into C1 and C2, with C2 being the best performing category.



Timber frame build methods that comply with Category B and C to reduce separating distances

Testing of certain timber frame build methods, (i.e. wall and floor panels) has demonstrated that the radiant heat and growth of fire can be reduced. 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.

UKTFA has developed supporting Technical Papers 1 to 3 provide information on the tests, methodology and frame categories.

UKTFA supporting Product Paper 4 provides the findings of the research work undertaken in the Spring and Summer of 2012. The results of the work are presented as a set of combined assemblies that can be selected by the timber frame supply chain to achieve the relevant timber frame category compliance.

Categories of timber frame build methods

The table below provides a list of generic timber frame solutions that achieve the relevant category of timber frame required.

| 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 UKFA 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 FI Build 1^(f) B2 As B1, plus pre insulated with type FI Build 2 ^(f) B3 As B1, plus pre insulated with type FI Build 3 ^(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 ^(l) 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 ^(l) 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 |
| 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) ^(l) 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 FI Build 1-3) ^(f) | | | | |
| Category C2 Fire Spread Resistant Frames (No Openings)⁽ⁱ⁾ | As C1 but no openings and external sheathing to be at least sheathing of limited combustibility ^(c) Note: Final design openings can be temporarily closed off | | | | |

Figure 3.2 Categories of generic standard timber frame build methods - refer to notes for explanations and further information

Notes relating to Figure 3.2 on previous page

- a 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.
- b Non-combustible boards will be products complying with BS 476 - part 4 or BS EN ISO 1182 euro class A1.
- c Boards of limited combustibility shall be products that comply with BS EN ISO 13823 euro class A2 and BS 476 - part 11.
- d Standard timber frame - typically combustible materials not treated with flame retardants.
- e Standard joists and decking - typically combustible materials not treated with flame retardants.
- f 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.
- g 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 greater than 55 degrees pitch | To be considered as an additional storey of timber frame |

- h 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.
- i 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.
- j 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.
- k Non load bearing walls (unsheathed) are untreated timber regardless of the category of timber frame.

Category B separating distance tables

Category B, reduced fire spread timber frame, where the timber frame structure itself will stop fire spread to varying degrees which reduces the potential fire growth and radiant heat generated. This category is subdivided into three to provide incremental improvements in different materials available to reduce the fire spread from fully a developed fire source. Under extreme circumstances frames in Category B walling may become fully involved in the fire but at a slower rate than Category A. The ability of Category B frames to stop small fires becoming established, as tested in the UKTFA methodology, is not included in the calculated separating distance tables as it assumed a fully developed fire from an external source has initiated the risk.

Table 2 for Category B1 - Timber frame separating distance (Sr) in metres

| 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 |

Table 3 for Category B2 - Timber frame separating distance (Sr) in metres

| Number of timber frame storeys | EMITTER LENGTH (eL) - B2 FRAME | | | |
|--------------------------------|--------------------------------|-------|-------|-------|
| | ≤5m | ≤10m | ≤15m | ≤20m |
| 1 | 5 | 5 | 5.25 | 5.5 |
| 2 | 5.25 | 7.25 | 8.5 | 9.5 |
| 3 | 6 | 9 | 10.75 | 12.25 |
| 4 | 6.75 | 10.25 | 12.75 | 14.5 |
| 5 | 7 | 11.25 | 14 | 16.25 |
| 6 | 7.25 | 12 | 15.25 | 17.75 |
| 7 | 7.5 | 12.75 | 16.25 | 19.25 |

Table 4 for Category B3 - Timber frame separating distance (Sr) in metres

| Number of timber frame storeys | EMITTER LENGTH (eL) - B3 FRAME | | | |
|--------------------------------|--------------------------------|------|-------|-------|
| | ≤5m | ≤10m | ≤15m | ≤20m |
| 1 | 5 | 5 | 5 | 5 |
| 2 | 5 | 6.25 | 7.25 | 7.75 |
| 3 | 5 | 7.75 | 9.25 | 10.25 |
| 4 | 5.5 | 8.75 | 10.75 | 12.25 |
| 5 | 5.75 | 9.5 | 12 | 13.75 |
| 6 | 6 | 10 | 13 | 15.25 |
| 7 | 6 | 11 | 13.75 | 16.25 |

Notes to tables 2,3 and 4

- 1 The data in these tables applies to projects with a total floor area greater than 600m².
- 2 The data in these tables is based on a nominal storey height of 3m. The tables assume the worst case of a 1m high parapet wall around the roof and that the roof has a slope of 55 degrees or less. Buildings with a roof pitch greater than 55 degrees and or a parapet higher than 1m shall add an additional storey height in the assessment.
3. Should a podium or higher ground levels be adopted then the actual number of storey levels of timber frame is used in the table.
4. The Category B frame emitter length is set to a maximum 20m. A building may have a length more than this, which for the use of this guidance will require appropriate vertical fire compartmentation to ensure that each emitter length between compartmentation is no greater than 20m. Emitter lengths greater than 20m will require assessment by a competent assessor and falls outside the scope of guidance.
5. The tables have been limited to a minimum separating distance 5m to account for flame impingement and spread by windblown flames. This assumes that the door/ window openings will allow flame spread to be the potential source of fire growth to neighbouring buildings and accounts for the effect of winds to carry the flames.

Category C separating distance tables

Category C, resistant to fire spread timber frames, where the structure itself will create a barrier to fire growth and if in the unlikely event a fire is established it will be restricted and not burn through the perimeter walling to the predefined compartmentation. Category C is divided into two with C1 being a fire resistant frame with openings and C2 being without openings or openings temporarily closed with the same product standard as the walls themselves. The ability of Category C frames to significantly stop small to moderate fires becoming established as tested in the UKTFA methodology is not included in the calculated separating distances as it assumed a fully developed fire from an external source has initiated the risk.

Table 5 for Category C1 - Timber frame separating distance (Sr) in metres

| Number of timber frame storeys | EMITTER LENGTH (eL) - C1 FRAME | | | |
|--------------------------------|--------------------------------|------|------|-------|
| | ≤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 |

Table 6 for Category C2 - Timber frame separating distance (Sr) in metres

| Number of timber frame storeys | EMITTER LENGTH (eL) - C2 FRAME | | | |
|--------------------------------|--------------------------------|------|------|------|
| | ≤5m | ≤10m | ≤15m | ≤20m |
| 1 - 7 | 0 | 0 | 0 | 0 |

Notes to tables 5 and 6

- 1 The data in these tables applies to projects with a total floor area greater than 600m².
- 2 The data in these tables is based on a nominal storey height of 3m. The tables assume the worst case of a 1m high parapet wall around the roof and that the roof has a slope of 55 degrees or less. Buildings with a roof pitch greater than 55 degrees and or a parapet higher than 1m shall add an additional storey height in the assessment.
3. Should a podium or higher ground levels be adopted then the actual number of storey levels of timber frame is used in the table.
4. The Category C frame emitter length is set to a maximum 20m. A building may have a length more than this, which for the use of this guidance will require appropriate vertical fire compartmentation to ensure that each emitter length between compartmentation is no greater than 20m. Emitter lengths greater than 20m will require assessment by a competent assessor and falls outside the scope of guidance.
5. Table 5 values have been limited to a minimum separating distance 5m to account for flame impingement and spread by windblown flames. This assumes that the door/ window openings will allow flame spread to be the potential source of fire growth to neighbouring buildings and accounts for the effect of winds to carry the flames. Closure of openings with a fire resistant board that is non-combustible or of limited combustibility will allow a reduction in the 5m limit and change Category C1 to Category C2.
6. Where Category C2 is used the framing needs to extend at least 5m back from the receiver face where it is required.

Principles of reducing separating distances using Category B or C frames

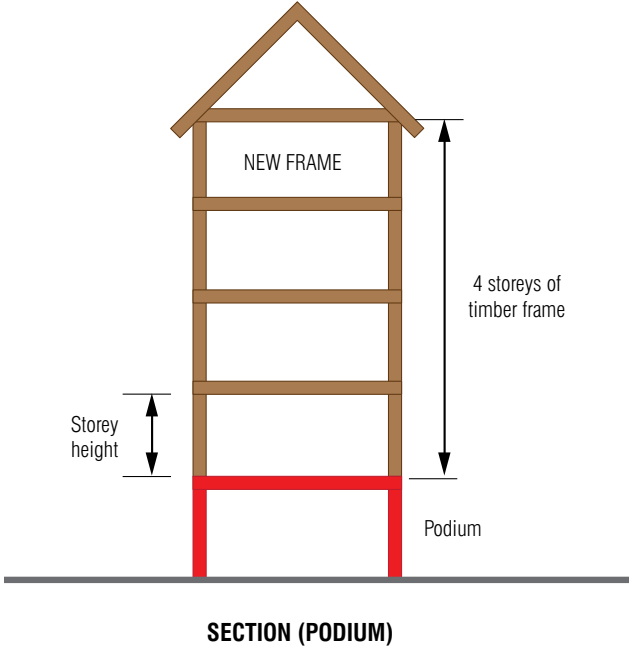
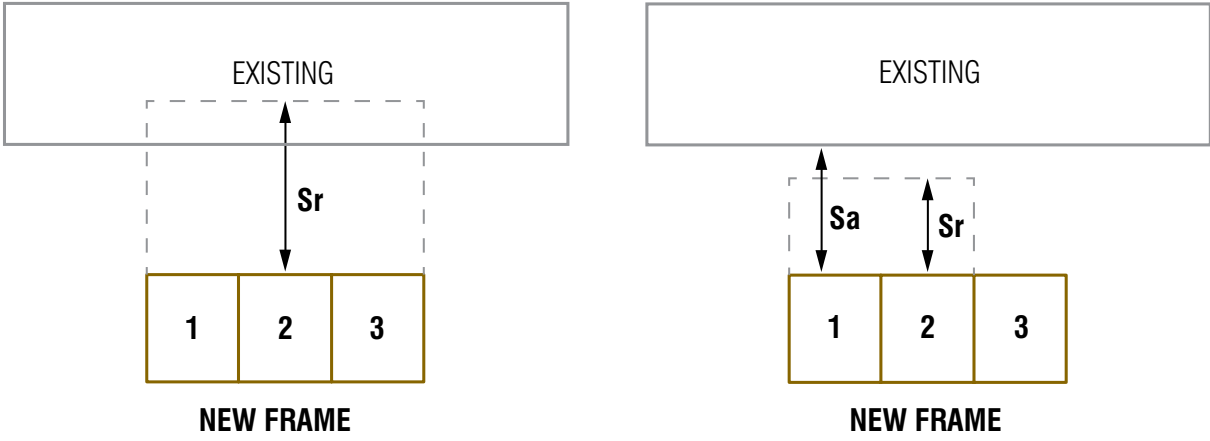
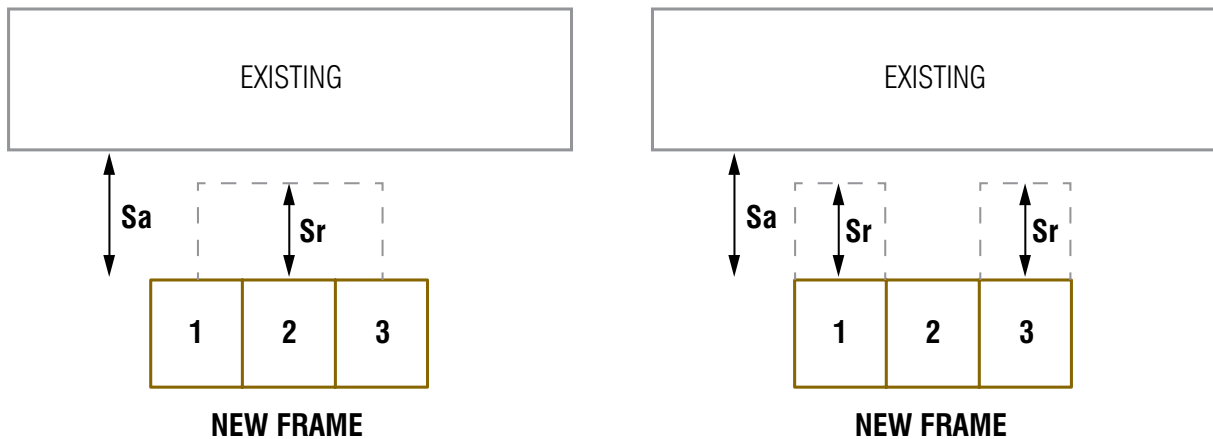


Figure 3.3 Example of storey heights and approach using podiums



Reducing the emitter length and temperature of a fire reduces the separating distance S_r . Category B or C frame types reduce both the emitter temperature and effective emitter length.

Figure 3.4a Basic explanation of why Category B and C frames reduce the separating distances



From the fire ignition source, the fire will spread horizontally and vertically. For example, a fire starting in unit 2 will attempt to spread to unit 1 and unit 3. The use of Category B forms of timber frame slows down the growth of fire such that it delays the spread between units. By the time the fire has reached unit 1 and 3, the fire in unit 2 will no longer be making a significant contribution to the radiant heat flux. For Category C frames the fire growth is compartmented further and very limited growth can be expected beyond the initial seat of the fire.

Figure 3.4b Basic explanation of why Category B or C frames reduce radiant heat and reduces the separating distances

Extreme condition compliance: Separating distances less than 5m

Where separating distances are less than 5m (for example, on infill sites), then the wall panels within the first compartment of the new build will form a fire compartment to the framing beyond this area. In this instance Category C2 frame types are required. And the C2 is to extend at least 5m back from the receiver face. The remaining building is to be Category C1 for at least the first compartment (minimum 20 metres or the building depth, whichever is the least).

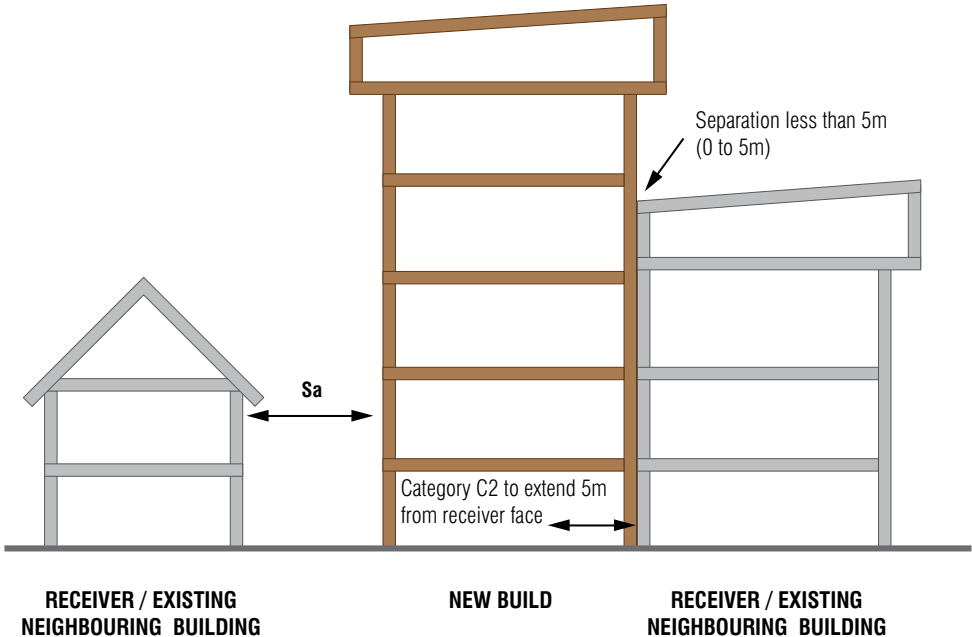


Figure 3.5 Example of extreme condition compliance: where separation distances are closer than possible using Category B or C1 (Elevation view)

Fire Compartmentation in Category B or C

The fire compartmentation can provide a reduction in emitter length within a building and can comprise of the following:

- 1 FR Build sheathing and timber frame party walls with full fill UKTFA fire tested insulation (FI Build) in the party wall cavity.
- 2 Non-combustible boards fixed to the party wall cavity face.
- 3 A non-combustible board on both faces to provide a continuous barrier.
- 4 For compartment walls, the continuity of fire spread resistance approach is to follow across floor levels and up to the top of the roof pitch level, so that there is no breach of fire spread compartmentation.
- 5 Openings for services and doors for access in any fire compartment wall are to be closed off with non-combustible board material to maintain the fire compartment resistance to fire spread.

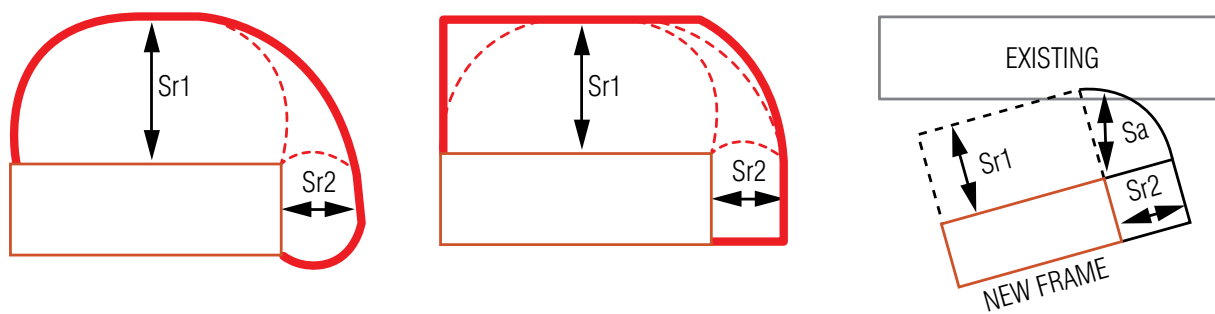
Combining Category B and/or C frames with A in a building

Combining a Category A frame with B or C is outside the scope of this guidance.

A fire engineer is to be consulted, should the combination of Category A with Category B and C frames in a building be considered.

Adopting the separating distance tables for buildings at angles to the new build

The separating distance table for Category B and C is based on 'parallel emitters and receivers'. The calculation approach for radiant heat flux is a complex assessment of the relationship between the emitter and receiver. Once the relationship between the emitter and receiver changes to a non-parallel condition the separating distance reduces for most applications. For the purpose of this guidance the separating distance calculation, based on the parallel relationship, is conservative and can be adopted as a guide. A reduced separating distance may result if a competent fire engineer was to assess the project.



Diagrammatic theoretical profile plan view of the radiant heat flux boundary for a given building.

Boundary based on 12.6 kW/m^2 at the receiver face.

Assumed profile for the radiant heat flux boundary for a given building.

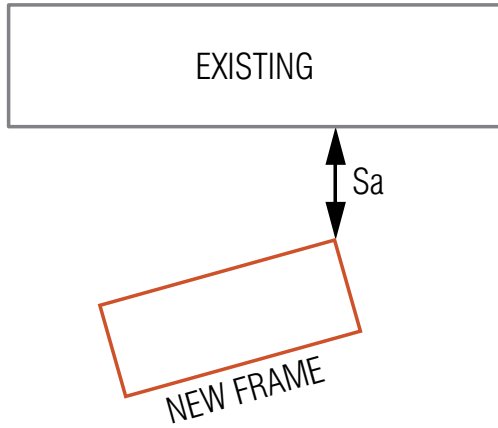
Boundary based on 12.6 kW/m^2 at the receiver face.

Principle applied at the junction of existing to new build.

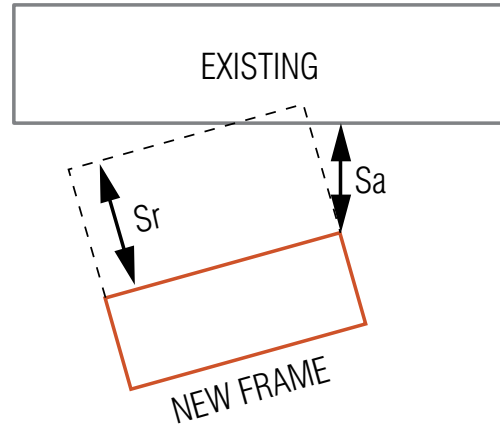
S_a is exceeded in the above example.

Figure 3.6 Buildings at angles to the emitter

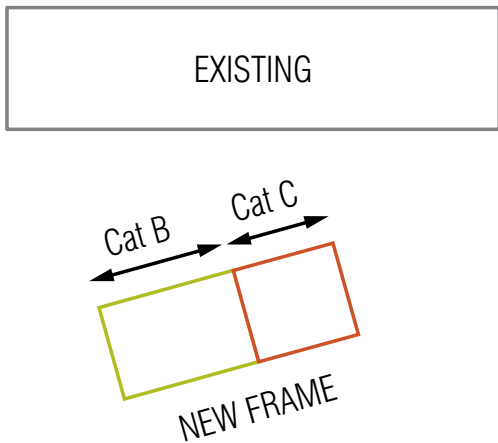
How this applies to the guidance is as follows:



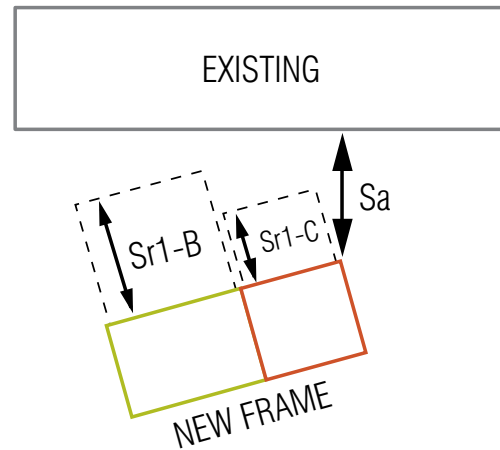
New build at an angle to the existing building.



Using the separating tables for a given emitter length the resultant separating distance S_r boundary impinges on the existing building line so $S_r > S_a$. Therefore mitigation measures needed.



Mitigation measures to the corner of the new build is required. The new build can be divided into distinct parts mixing Category B and Category C in areas where higher risk mitigation is required.



The radiant heat flux from a reduced emitter that adopts Category C frame = S_{r1-C} . This provides sufficient separation from the existing building.

S_{r1-B} provides sufficient separation and does not impact on the receiver.

Figure 3.7 Examples of the guidance in buildings at angles to the emitter



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