QUALITY ASSURED UKTFA

SITE SAFE

Design guide to separating distances during construction

For timber frame buildings and projects above 600m^2 total floor area

Part 2 - Standard timber frame and construction process mitigation methods

Version 1 - December 2011

HSE

THE UK TIMBER FRAME ASSOCIATION

PART 2

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Foreword by the Health and Safety Executive

HSE welcomes this guidance from UKTFA. Fire is a hazard during most construction processes and it is imperative that precautions are in place to both prevent fires and ensure that people can escape to safety if fire does occur. In 2010, HSE published revised guidance on fire in construction and more recently, 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 timber frame fires 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. This new UKTFA document captures current scientific knowledge on fire behaviour in such structures and allows a sensible assessment to be made of specific proposals and sites to ensure that effective precautions can be taken to protect all stages of construction. The guidance provides a sound basis for decisions and can be amended and developed further in the light of experience. HSE will continue to work with UKTFA on this issue but in the mean time commends this guidance to the industry.

Philip White
Chief Inspector of Construction
Health and Safety Executive
November 2011

Introduction

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 Part 1 of the guidance. The technical data in this guide is based on a conservative calculation model backed by tests to determine the exposure of a neighbouring building to heat radiation during a site fire event. To keep the process straightforward there are a number of underlying assumptions and simplifications to the model used to calculate the separating distances. As an alternative to this guidance, a more precise assessment by a competent fire engineer can be undertaken. Technical Paper 1 and Paper 2 gives information that will enable fire engineers to provide these assessments on a consistent basis..

The Guidance is in 3 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

Separating distances for standard timber frame (Category A)

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

Number of timber frame storeys	EMITTER LENGTH			
	$\leq$10m	>10m $\leq$20m	>20m $\leq$25m	>25m
1	7	7	8	9
2	10	11	14	16
3	12	13	17	22
4	14	16	20	28
5	15	18	23	33
6	16	20	25	36
7	17	21	27	40

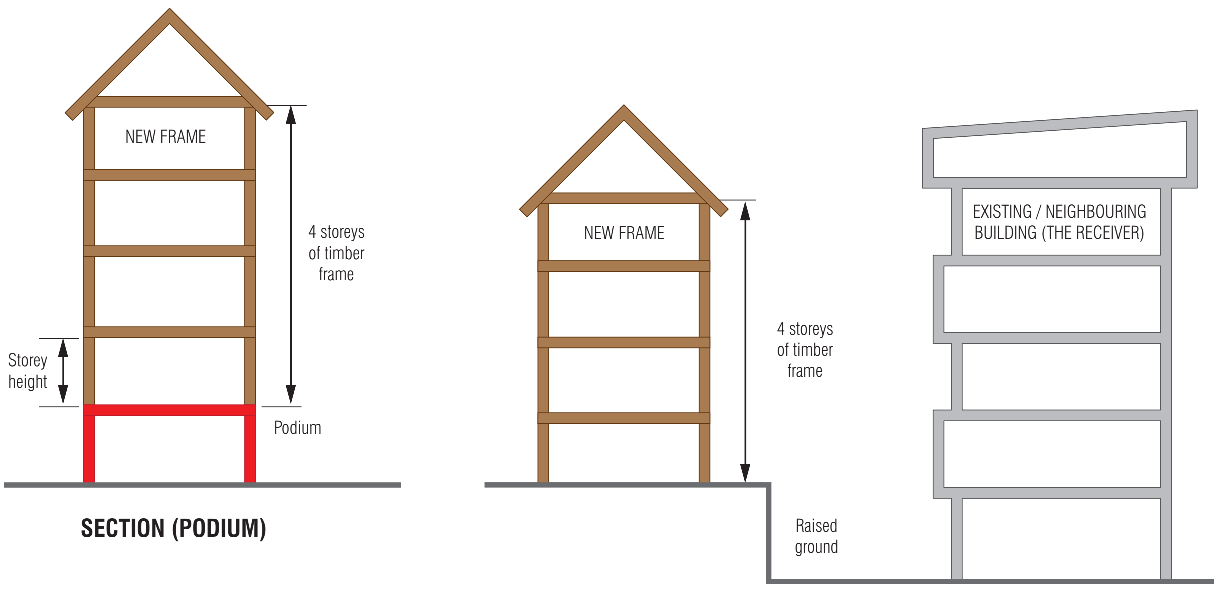
Notes:

1 The data in this table applies to projects with a total floor area greater than 600m^2. 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.



SECTION (PODIUM)

SECTION (RAISED GROUND)

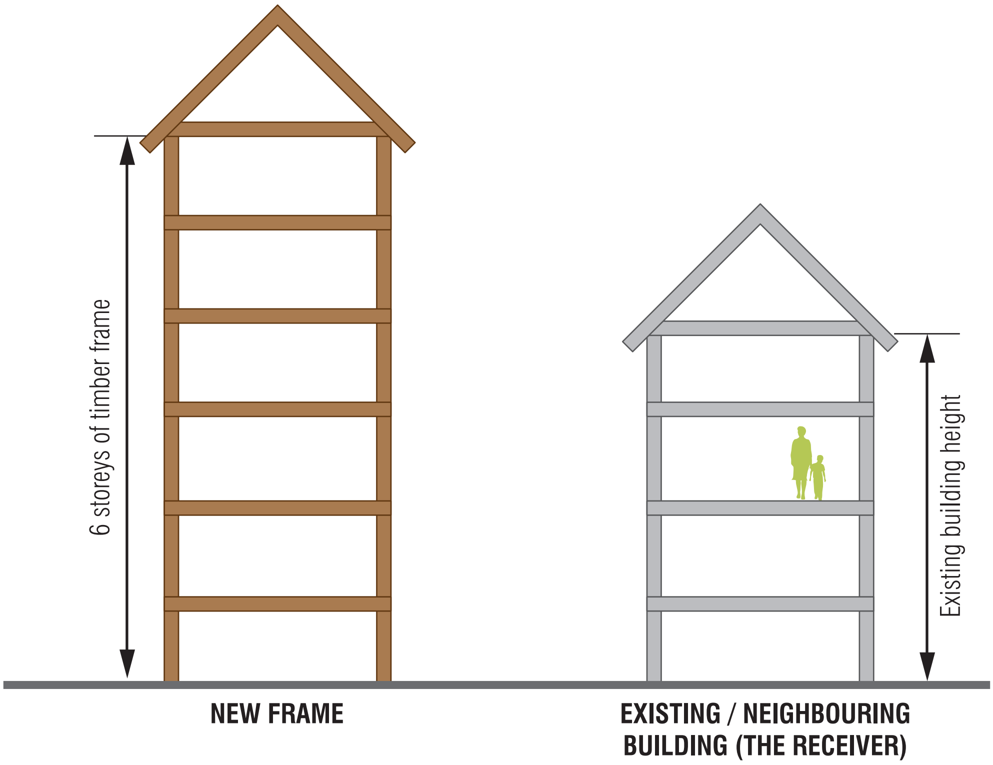
Figure 2.1 Example of storey heights and approach using podiums or raised ground

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. Each floor to floor level is taken as a nominal 3m.

Example Step 1 (a)
6 storey emitter



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

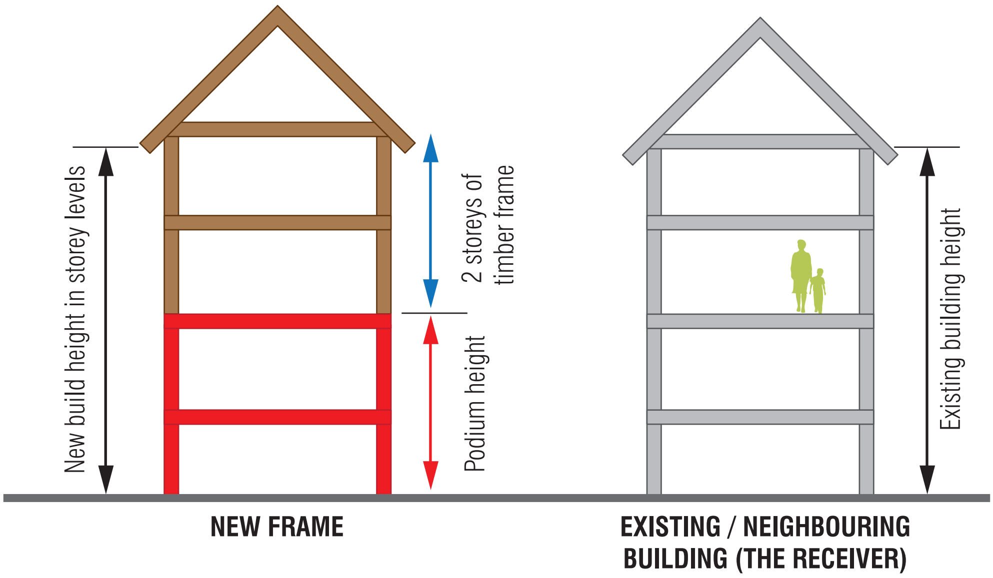
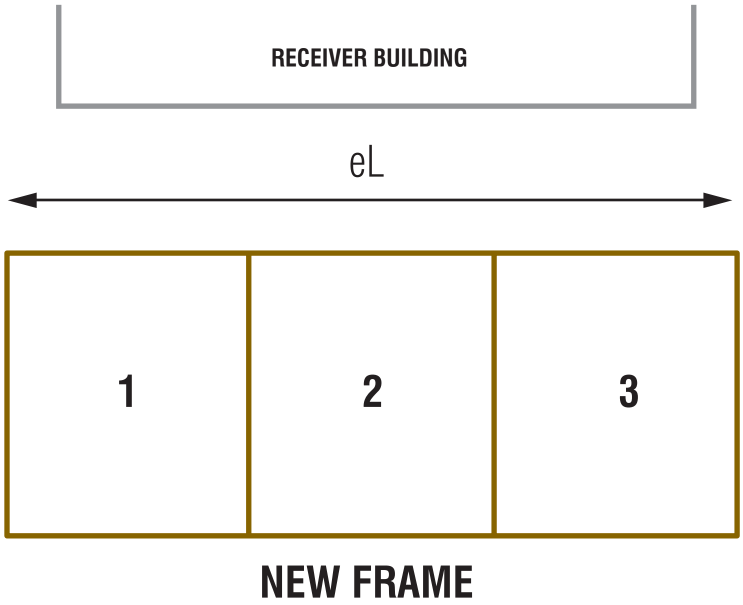


Figure 2.2 Storey height of emitter

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.

Example
The emitter length (eL) on the elevation facing the receiver building



Example
The emitter length (eL) on the elevation facing the receiver building

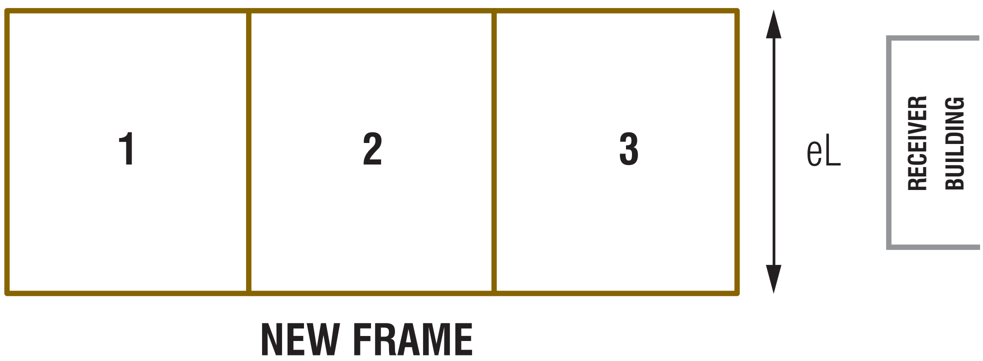


Figure 2.3 Emitter lengths

Step 3: Separating distance (Sr) from table

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

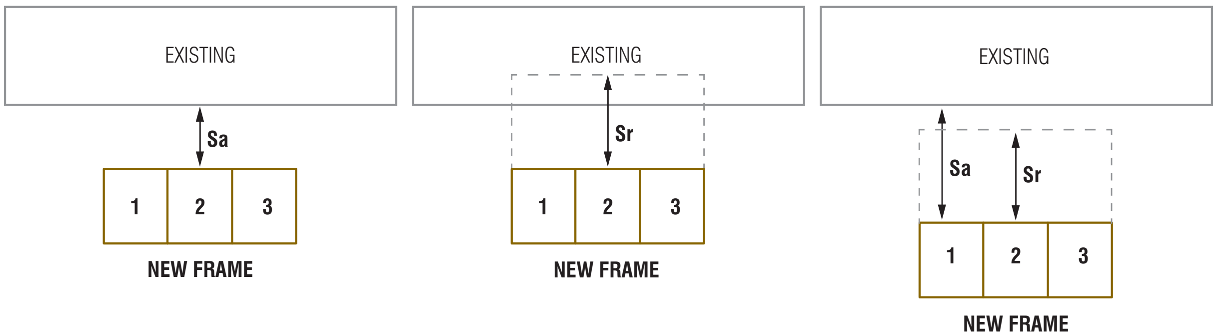
For example, a project with no podium, for a 3 storey emitter facing a 4 storey receiver, with length (eL) of 14m the separating distance (Sr) = 13m as read from the Category A table.

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

Number of timber frame storeys	EMITTER LENGTH			
	≤10m	>10m ≤20m	>20m ≤25m	>25m
1	7	7	8	9
2	10	11	14	16
3	12	13	17	22

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

The separating distance (Sr) derived from the table is checked against the actual distance (Sa) between the emitter and receiver. This can be done diagrammatically by drawing a rectangle (Sr) 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 on page 10 of this document.



Sa = actual separating distance

Sr is the separating distance from the tables

If Sr > Sa then mitigation measures are needed

Sr is the separating distance from the tables

If Sr < Sa then no mitigation measures are needed

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

Examples of timber frame separating distance measurements

Project Example 1

A block 3 storeys high 13.5 metres long is opposite a two storey house outside the site boundary 18 metres from the proposed timber frame.

	No of Storeys	Actual distance Sa between Emitter and Receiver	Emitter Length eL
Emitter	3	18m	13.5m
Receiver	2		n/a
No Podium	n/a	n/a	n/a

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

Number of timber frame storeys	EMITTER LENGTH			
	≤10m	**>10m ≤20m**	**>20m ≤25m**	**>25m**
1	7	7	8	9
2	10	11	14	16
3	12	13	17	22

From Table 1, the minimum separating distance is 13m. Therefore, no additional measures are required.

Project Example 2

A residential block 45 metres long with six floors including a single storey concrete podium: running parallel to the main road is proposed. 17.5m away (opposite the proposed block and also running parallel to the road) is a two storey brick faced building with ground floor shops and with apartments above.

	No of Storeys	Actual distance Sa between Emitter and Receiver	Emitter Length eL
Emitter (timber frame element)	5	17.5m	45m
Receiver	2		n/a
Podium	1		n/a

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

Number of timber frame storeys	EMITTER LENGTH			
	≤10m	>10m ≤20m	>20m ≤25m	>25m
1	7	7	8	9
2	10	11	14	16
3	12	13	17	22
4	14	16	20	28
5	15	18	23	33

From Table 1, the minimum separating distance required is 33m. Therefore, additional fire mitigation measures are required.

Construction process mitigation measures to reduce the separating distance (so that Sr < Sa)

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

a Adopt a more fire resistant timber frame specification (Refer to Part 3).

b Introduce fire barriers with fire doors (if required) to reduce the emitter length to form vertical compartmentation. Fire barriers are to extend at least 5m in either direction perpendicular to the compartmentation line being considered to stop flame growth around the edges of the barrier. The fire barrier is to be robust and not rely on exposed timber elements for support. Note that barriers should be continuous, including through the floor zones and the stability of the barrier should be considered if the timber frame elements have burnt away. This clause also refers to the application of temporary or permanent fire shields.

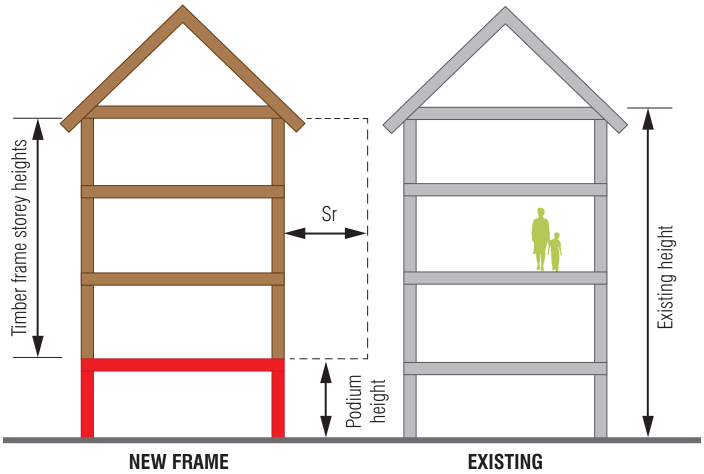
c Changing the emitter footprint and / or orientation to avoid risk mitigation requirements.

d The use of build process to construct a permanent fire shield 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 fire shield is never exceeded beyond what is calculated as the risk mitigation measure.

e Adopt podium structures to reduce the timber frame height.

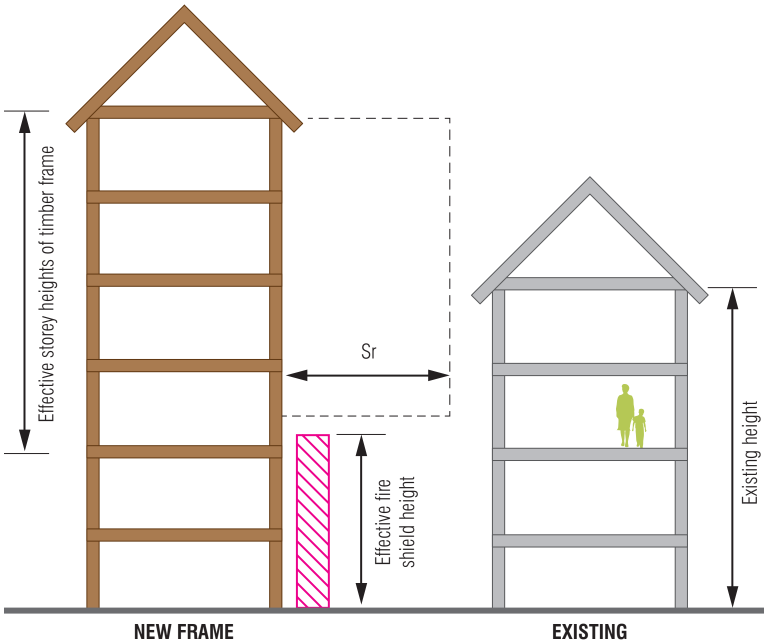
f The use of other mitigation processes such as sprinklers or water canons can be considered but require a competent fire engineer to assess the suitability of a system matched to the site conditions, resistance against arson, accidental damage or weather damage. The potential for fire to occur on the external face is to be considered.

This example illustrates 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.



Fire shield option

Non-combustible cladding attached to the timber frame, built up as the work progresses to reduce the emitter height to ensure Sr is less than Sa. In the example opposite the 6 storey height new build has been reduced to 4 storey height in terms of determining the separating distance.

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

Figure 2.5 Podium and fire shield options

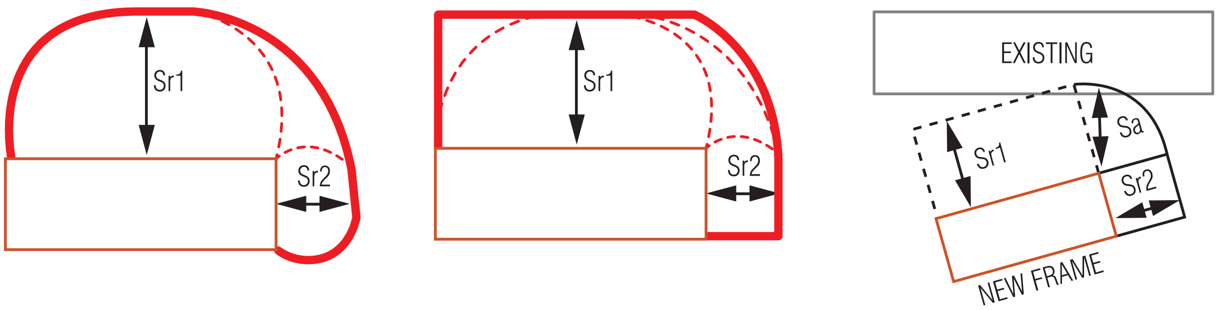
Timber frame build methods to reduce the separating distance (Category B and C)

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 barrier 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

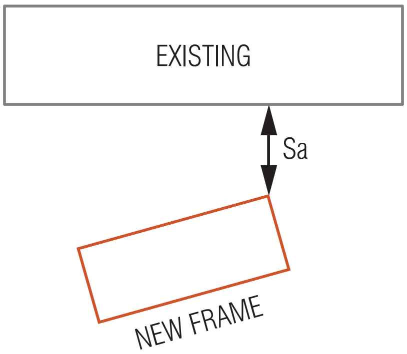
The separating distance table on page 4 of this document is based on 'parallel emitters and receivers'. The calculation approach for radiant heat flux is a complex assessment of the relationship between the emitter and receiver. Once the relationship between the emitter and receiver changes to a non-parallel 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.



Diagrammatic theoretical profile plan view of the radiant heat flux boundary for a given building. Boundary based on 12.6 kW/m² at the receiver face.	Assumed profile for the radiant heat flux boundary for a given building. Boundary based on 12.6 kW/m² at the receiver face.	Principle applied at the junction of existing to new build. Sa is exceeded in the above example.

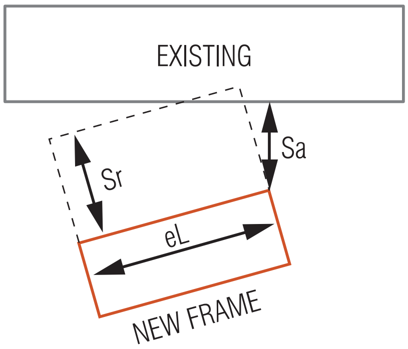
Figure 2.6 Buildings at angles to the emitter

An example of how this applies to the guidance



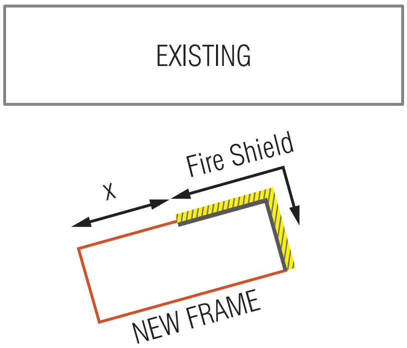
New build at an angle to the existing building.

Figure 2.7a



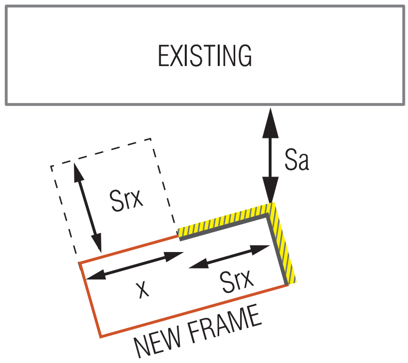
If using the separating tables for a given emitter length (eL) and it is found that the Sr rectangle boundary impinges on the existing building line so that Sr > Sa, then mitigation measures are needed.

Figure 2.7b



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 fire shield strategy to the corner elements - such design falls outside of the scope of the tables and requires assessment by a fire engineer to ensure that the fire growth does not wrap around the fire shield and that the fire shield remains intact whilst the remainder of the timber frame is assumed to have burnt away. Conservative assessments for the length of the fire shield are given in Figure 2.7d.

Figure 2.7c



With the fire shield 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 2.7d

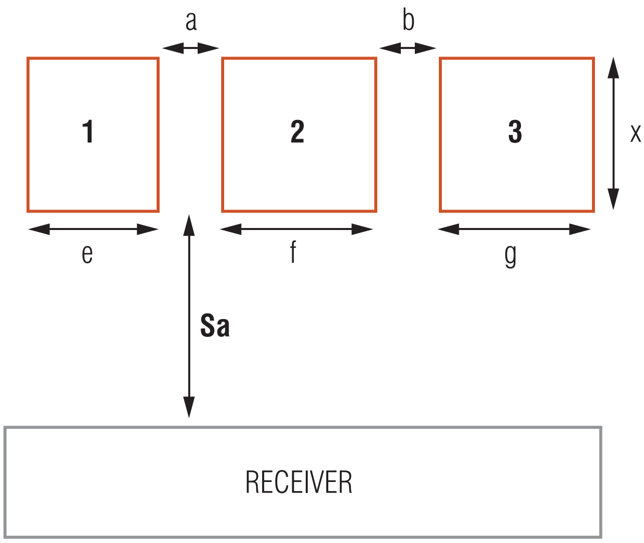
On-site influences to off-site separating distances

Where a site has a number of new build frames, being constructed on the same site, then the assessment of radiant heat flux may be influenced by the accumulation of fire growth across the new buildings, if the fire can spread from one building to the next. The separating distance between the new buildings may provide a natural fire break, but may also be close enough to allow ignition of the adjacent frame. It is possible that a number of buildings can become ignited at a rate at which the new buildings are to be considered as one combined emitter length for the application of the separating distance tables in order to assess the radiant heat to buildings off the site.

An assessment of the separating distance between the new frames should be carried out, but with recognition that the gap will provide some resistance and possible delay in fire spread. The assumption has been taken throughout the assessment work that direct fire spread by flame contact can occur where there is up to a 5m separation gap. So frames built at 5m or closer are to be considered as having no fire break and the length of the frames are to be combined to calculate the emitter length for the tables.

For gaps between new Category A frames greater than 5m, a separating distance assessment may be taken using Category B separating distance tables that are given in Part 3 of the guidance. If the separating distance between the new frames is below the Category B table results, then the emitter length shall be based on the combined length of the new frames.

By way of explaining how the combination of buildings on a site can influence the off-site radiant heat flux assessment the following example is given:



Emitters 1, 2 and 3 are two storey detached dwellings.

For this example let's take the total dimensions for units as:

e = 10m

f = 12m

g = 12m

x = 9m gable end

Figure 2.8 Combination of units on a site and impact of the emitter length for off site assessment

The example is to show how to determine the emitter length to be used in the Category A tables. This will then enable the appropriate separating distance to the off-site neighbouring building to determine when multiple frames are being constructed.

Emitter length (eL) is determined from a review of the gap between the multiple units on the site.

Taking Category A frames the gap between is checked as follows:

For direct flame contact check the following: If a or b ≤ 5m, then eL = e+ f + g (assuming both a and b > 5m)

For fire spread check distances as follows: If a or b >5m, then a separating distance check is carried out using the gable lengths as the emitter length. Then use the Category B tables in Part 3 of the guidance to account for flame spread delay in the gap.

Therefore if a or b > Sr from the tables, then the emitter length for the off-site separation distance can be taken as e, f , or g.

If a or b < Sr from the Category B tables,the emitter length is to be taken as the combined length of new frames. For example if both a and b < Sr then the combined emitter length is to be used in the Category A tables for separating distance to off-site neighbouring building. In the example this is e + f + g. If only a > Sr then the emitter width is e + f or g whichever is the greater.

For the example given with a 9m gable length the Sr from Part 3, Table 2, is 8.25m. Therefore, if a and b are 6m,then the emitter length for off-site separating distance is to be based on e + f + g.

The emitter length of the new build multiple frames can be reduced by providing fire breaks such as omitting a frame until the adjacent frames have been completed with a non-combustible cladding if the resultant temporary gap is sufficient. Alternatives are to consider Category C frames or temporary fire shields.

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