Design guide to separating distances during construction

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

Part 1 - Background and introduction

Version 1 - December 2011

HSE

THE UK TIMBER FRAME ASSOCIATION

PART 1

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

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. Accordingly, for sites that fall within the limitations explained below, the use of this document as the basis for the development of a site fire risk plan is sufficient to address the requirements of HSG168. The engagement of specialist fire engineers is only envisaged for particularly onerous sites or where specific risk factors make this guidance too conservative.

The guidance is aimed at the commercial construction market where multiple houses, flats or rooms for residential purposes are built. 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 600m^2 of total floor area or where developments comprise two or more blocks of timber frame buildings where each block is greater than 300m^2 of total floor area.

The calculations in this guidance complement, and are dependent on, contractors following 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 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

HSG 168 "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 along with FERMI, fire engineering consultants, and Martin Milner, UKTFA Technical Consultant in the preparation of this guidance.

'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

Supporting documents - Technical background and compliance testing procedures for timber frame build methods determine separating distances:

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

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.

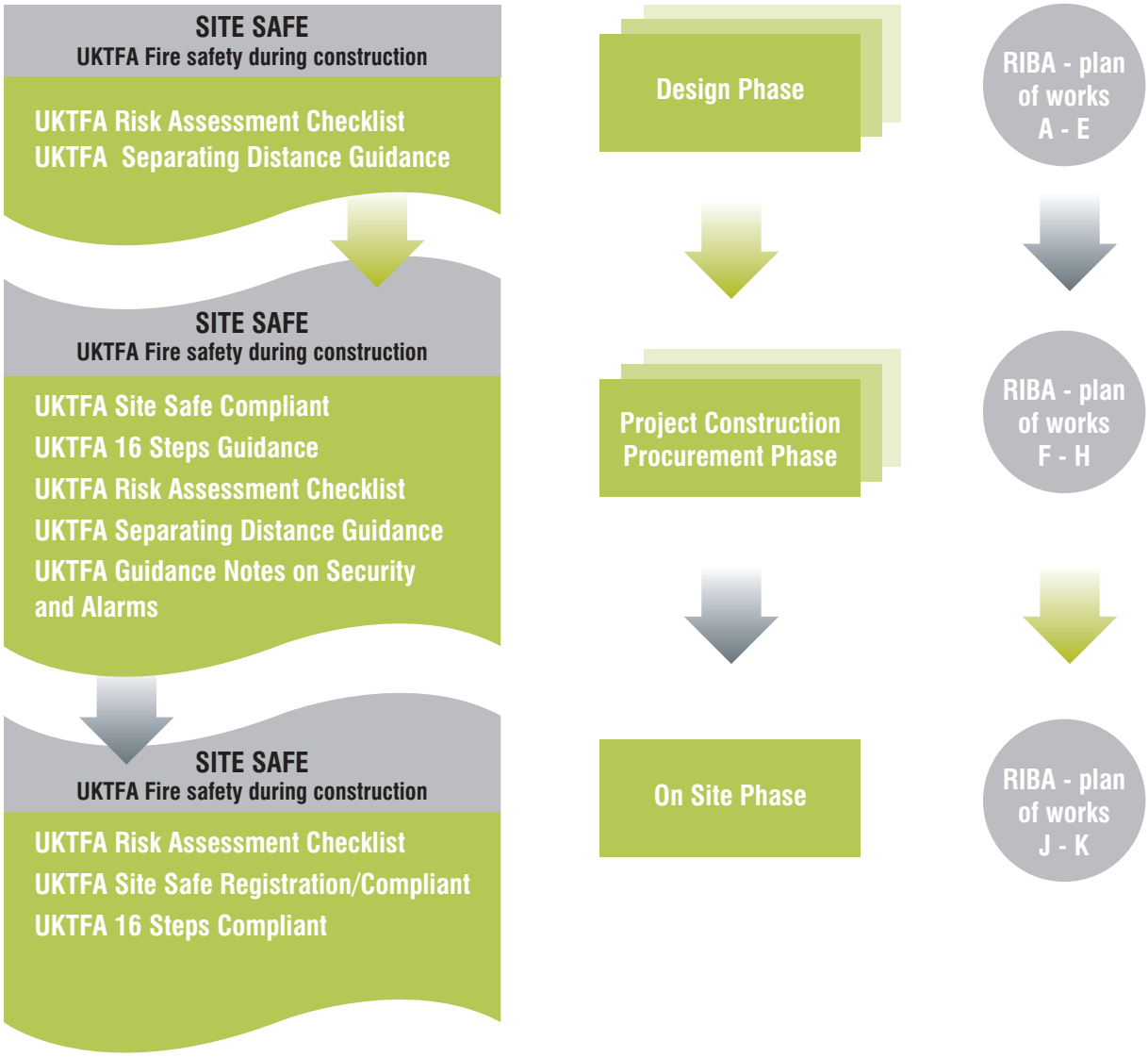


Figure 1.1 UKTFA Site Safe strategy documents and point of application

Introduction

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 neighbouring building usage increases the risks beyond the domestic, hotel, student accommodation or school type usage 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-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

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

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).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 three of 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/m^2 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 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 HSG 168.

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 45 degree pitched roof. 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 3 specifications for 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 standardised 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 mixes that has undergone the methodology described in Technical Paper 3. The list of systems and products are available from the UKTFA web site. No products, components or systems can be claimed to satisfy in full or in part the requirements of Category B or C until they are listed on the website.

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

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 barrier / Fire shield

A surface that can resist fire with integrity, insulation and limited flame spread. A fire barrier is typically supported by the timber frame structure whereas a fire shield is usually remote from the structure and independently supported. Collapse of the wall attached to timber frame should be considered in adopting fire barriers and shields. The fire shield may be an approved material that is not part of the timber frame building package. Approval is to be based on evidence from tests carried out to the UKTFA product test methodology (see Technical Paper 3). The UKTFA test programme for the complete systems can be adopted to test the performance of the fire shield and checked for integrity and insulation, plus fire spread around the edges.

Fire doors

A self-closing fire door provides access though a fire barrier or compartment wall 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).

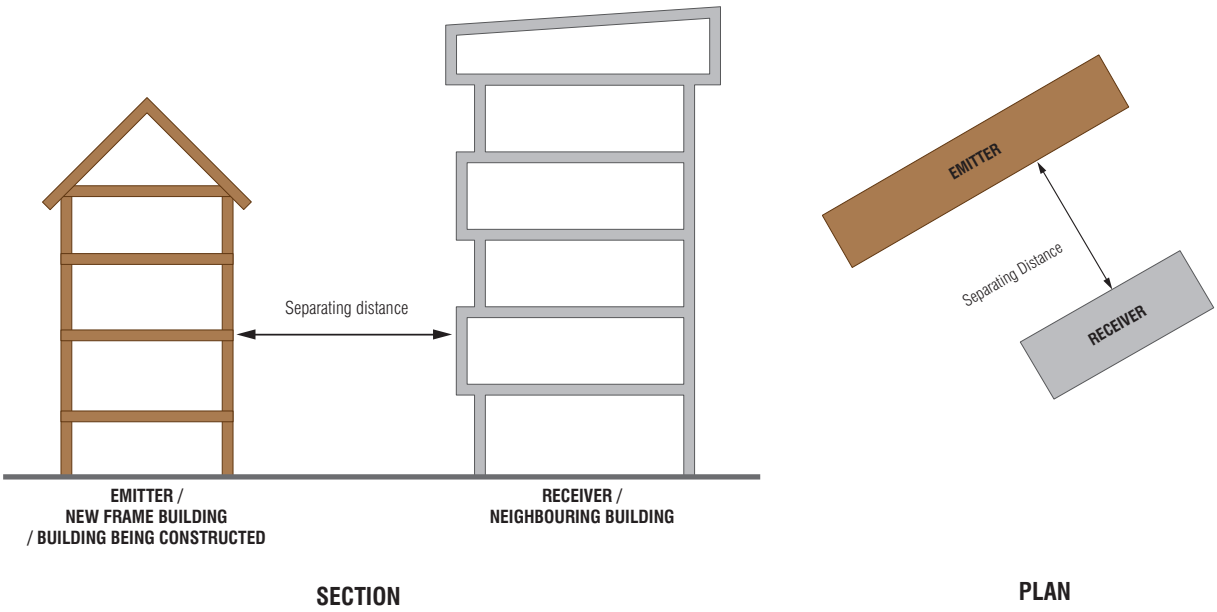


Figure 1.2 The separating distance is the nearest point between the emitter and receiver

Compartmentation

In the context of the building during construction, compartmentation is taken to be a vertical or horizontal fire barrier. It is not used in the same manner as defined in Building Regulations. Note that due to the construction process and external site conditions the use of horizontal compartmentation requires practical consideration.

Timber frame category

The tables are based on 3 specifications of timber frame with increasing fire resistance. The data in the tables provides separation distances for three specifications of timber frame.

Category A - Standard open panel timber frame

Category B - Reduced fire spread timber frame

Category C - Fire spread resistant timber frame

Each category refers to the reaction of timber frame systems to fire on a construction site and not the component parts so that the floor and walls are considered as a whole, and not as the current practice for materials within British and European standards that consider each product performance in isolation.

On-site and off-site definitions

The term off-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-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-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-site separation.

Each new building, depending on the build sequence, requires its own risk assessment of the off-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.

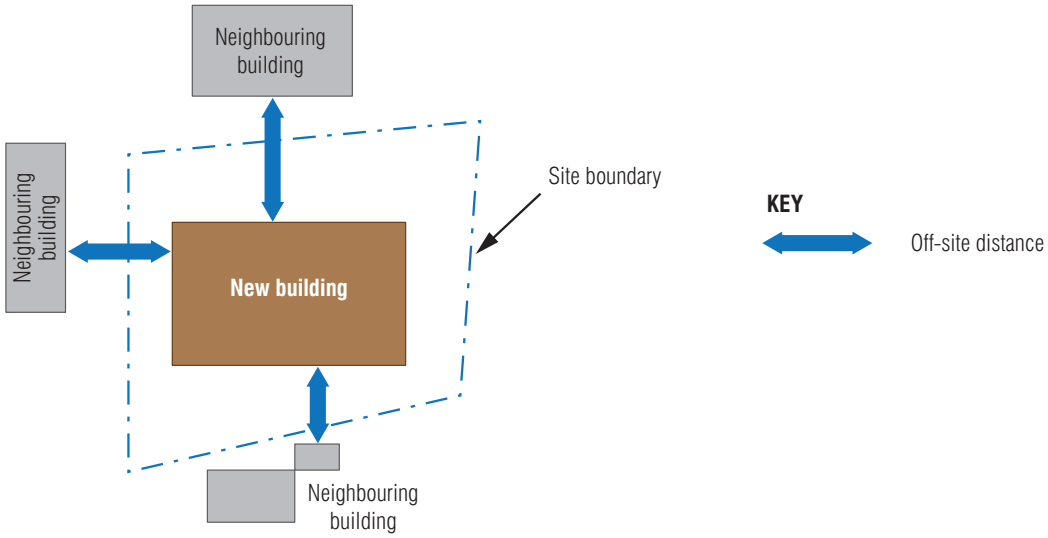


Figure 1.3

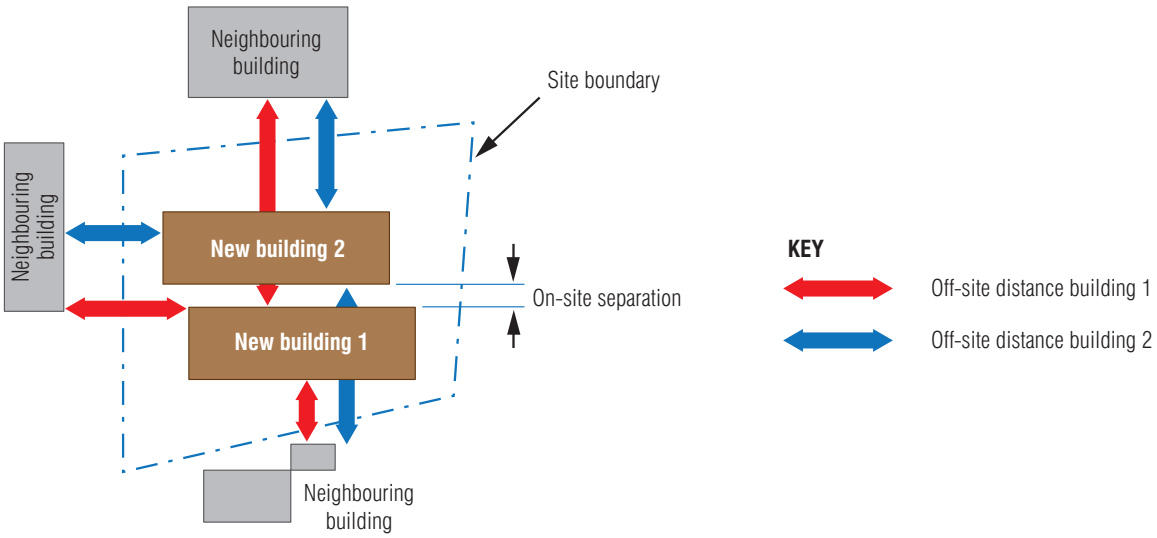
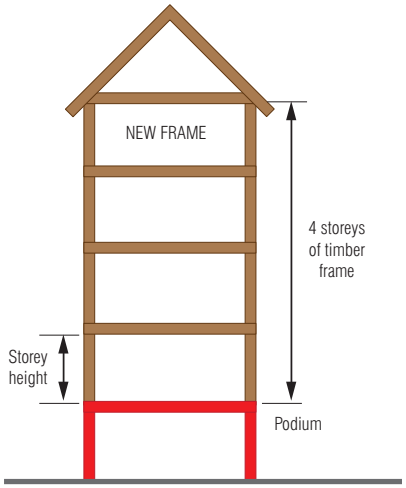


Figure 1.4

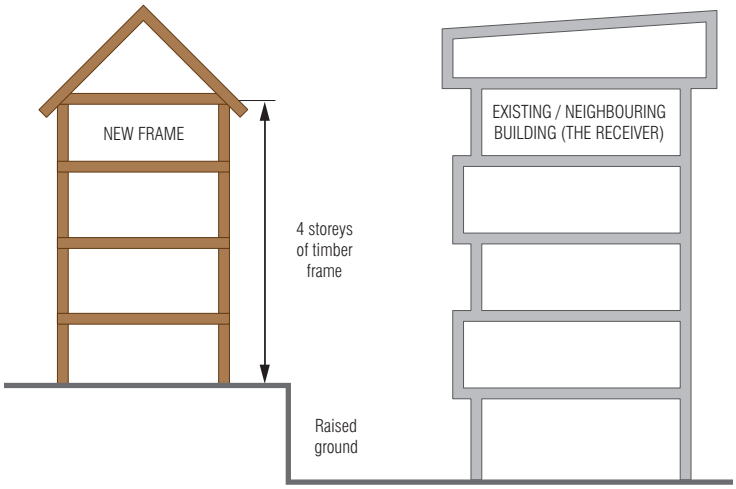
Podium and higher ground levels

The podium is taken as a non-combustible element of structure, e.g. a concrete structure and/or a steel structure without timber frame infill walls, 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.



SECTION (PODIUM)



SECTION (RAISED GROUND)

Product approvals

All products and systems 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 or C until they are listed on the website.

Acknowledgements

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