Design guide to separating distances during construction

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

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

Version 1 - December 2011

HSE

THE UK TIMBER FRAME ASSOCIATION

PART 3

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

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 and mitigation measures are needed, the designer can adopt either construction process mitigation methods or 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 C is subdivided into C1 and C2, with C2 being the best performing category.

Specific 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 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.

Supporting Technical Papers 1 to 3 provide information on the tests, methodology and frame categories.

Categories of timber frame build methods

<table>
<tr><th>Brief Description</th><th>External Walls</th><th>Load Bearing Internal Walls</th><th>Compartment Walls</th><th>Floor/ flat roofs[g]</th><th>Pitched Roofs</th></tr>
<tr><td>Category A
Standard Timber Frame</td><td>Standard timber frame and sheathing [d]</td><td>Standard timber frame and sheathing [d]</td><td>Standard timber frame and sheathing[d]
Party wall cavity insulation
or sheathing of limited combustibility or better
Max centres 25m</td><td>Standard joists and decking[e]</td><td rowspan="4">Either timber trusses or rafters and purlins</td></tr>
<tr><td rowspan="2">Category B
Reduced fire spread frames</td><td>FR Build[a] timber frame and FR Build[a] sheathing or sheathing of limited combustibility or better</td><td rowspan="3">Sheathed walls
FR Build[a] studs FR Build[a] sheathing or sheathing of limited combustibility[c] or better
or non FR Build[a] studs with sheathing of limited combustibility[c] or better on both sides
Unsheathed walls
FR Build[a] studs</td><td rowspan="3">FR Build[a] timber frame FR Build[a] sheathing plus
Party wall Cavity insulation
or sheathing of limited combustibility or better
or non FR Build[a] studs with sheathing of limited combustibility[c] or better on room side
Max centres 20m</td><td rowspan="3">FR Build[a] joists
FR Build[a] decking boards or boards of limited combustibility[c] or better</td></tr>
<tr><td>FI Build[f] pre-insulated wall frames - with FR Build[a] sheathing or boards of limited combustibility[c] or better</td></tr>
<tr><td>Category C1
Fire spread resistant frames</td><td>Standard timber frame[d] with non-combustible sheathing
or FR Build[a] timber framing 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</td></tr>
<tr><td>Category C2
Fire spread resistant frames no openings</td><td>As C1 but no openings and external sheathing to be at least sheathing of limited combustibility[c]
Note: openings can be temporarily closed off with sheathing of limited combustibility</td><td></td><td></td><td></td><td></td></tr>
</table>

Figure 3.2 Categories of timber frame build method (see notes on next page)

Notes relating to Figure 3.2 on previous page

a FR Build is a classification of flame retardants 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.

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-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.

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.

Category B and C1 separating distance tables

Table 2 for Category B - Timber frame separating distance (m)

Storey levels of timber frame(Note (h))	EMITTER LENGTH			
	≤5m	≤10m	≤15m	<20m(Note (i))
1	4	5.5	6	6.5
2	6	8.25	9.75	11
3	7	10.25	12.5	14
4	7.5	11.75	14.5	16.5
5	8.25	12.75	16	18.5
6	8.25	12.75	16	18.5
7	8.25	12.75	16	18.5

Table 3 for Category C1 - Timber frame separating distance (m)

Number of timber frame storeys(Note (h))	EMITTER LENGTH			
	≤5m	≤10m	≤15m	<20m(Note (i))
1	5	5	5	5
2	5	5	5	5
3	5	5	5.75	6.25
4	5	5.5	6.75	7.75
5	5	6	7.5	8.75
6	5	6	7.5	8.75
7	5	6	7.5	8.75

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 Table is based on a nominal storey height of 3m.

3 Timber frame methods that fall within Category B and C require compartmentation at a maximum of 20m. Compartments of this size have been proven by test to resist spread of fire due to the reduced fire intensity in the compartment on fire. See section on compartmentation.

4 The tables have been limited to a minimum separating distance 5m to account for flame spread. 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 the category to C2 - see Table 4.

5 The receiver height does influence the radiant heat on the surface of the building but for simplicity this aspect is removed from the tables which assumes that the receiver is 3 or more storeys in height.

6 Should a podium or higher ground levels be provided then the actual number of storey levels of timber frame is used in the table.

Principles of reducing separating distances using Category B and C frames

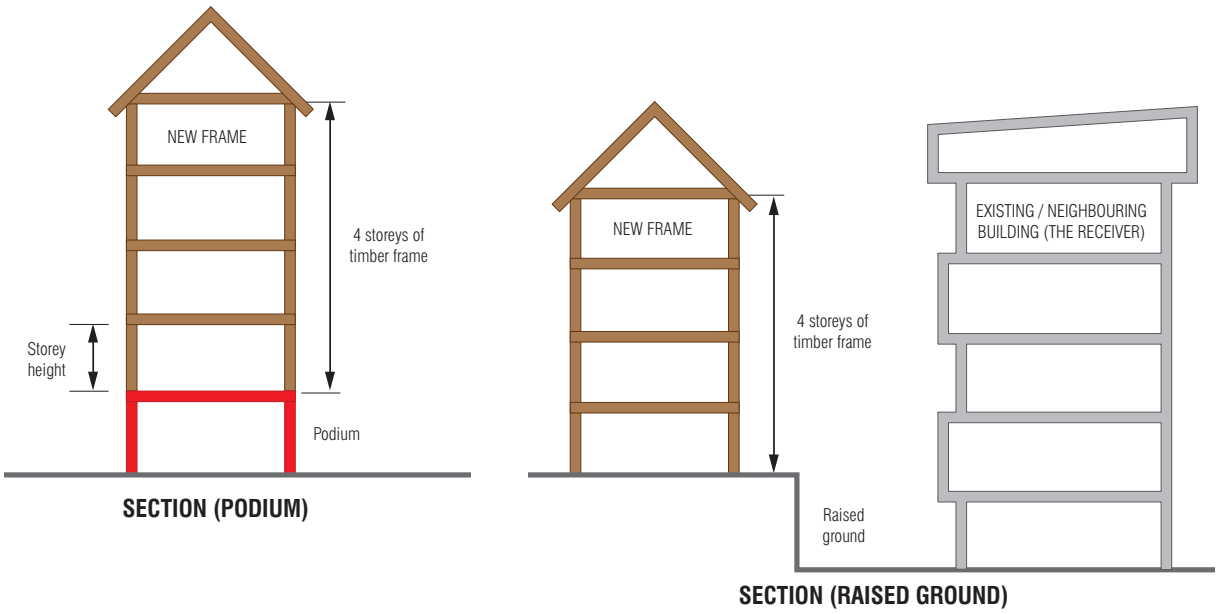
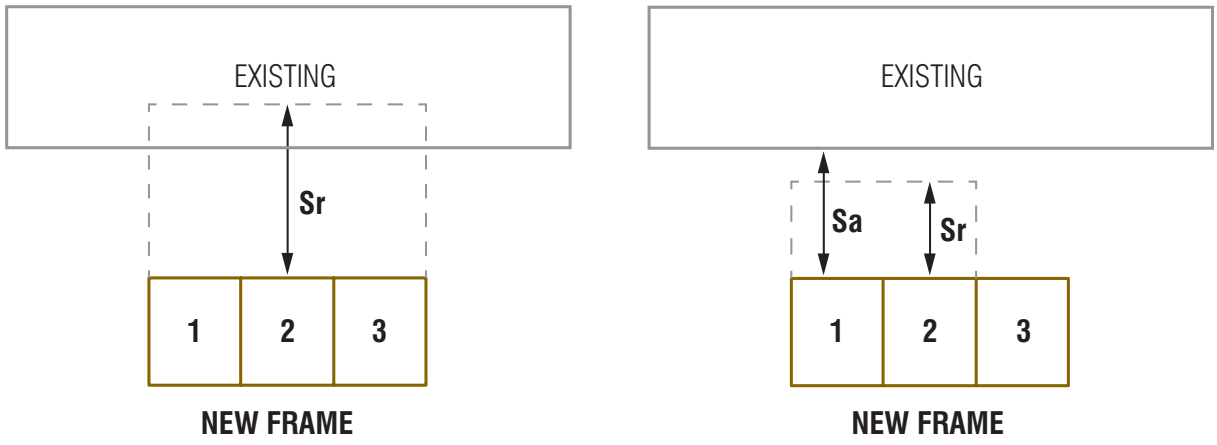
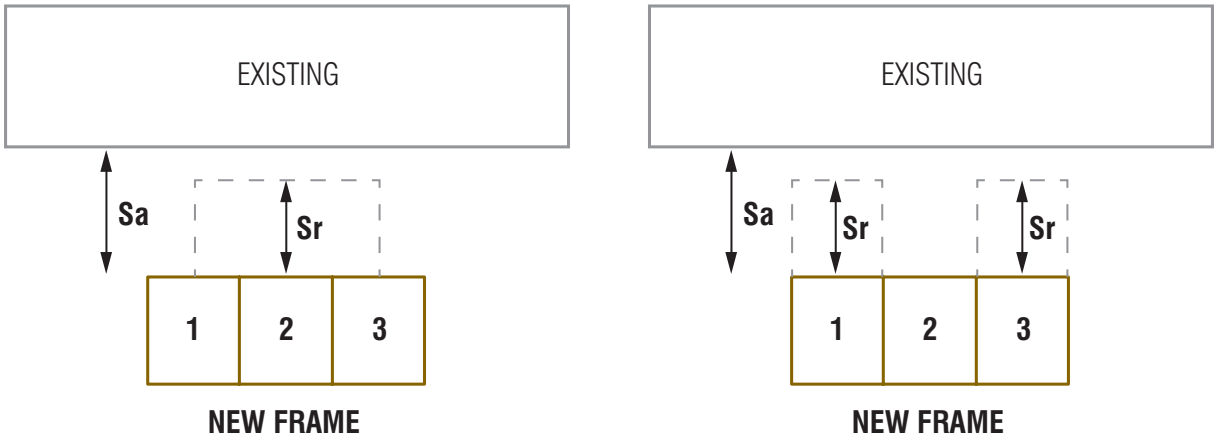


Figure 3.3 Example of storey heights and approach using podiums or raised ground (same principles as Category A frames)



Reducing the emitter length and temperature of a fire reduces the separating distance Sr. Category B and 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 and C frames reduce radiant heat and reduces the separating distances

Extreme condition compliance: Separating distances less than 5m

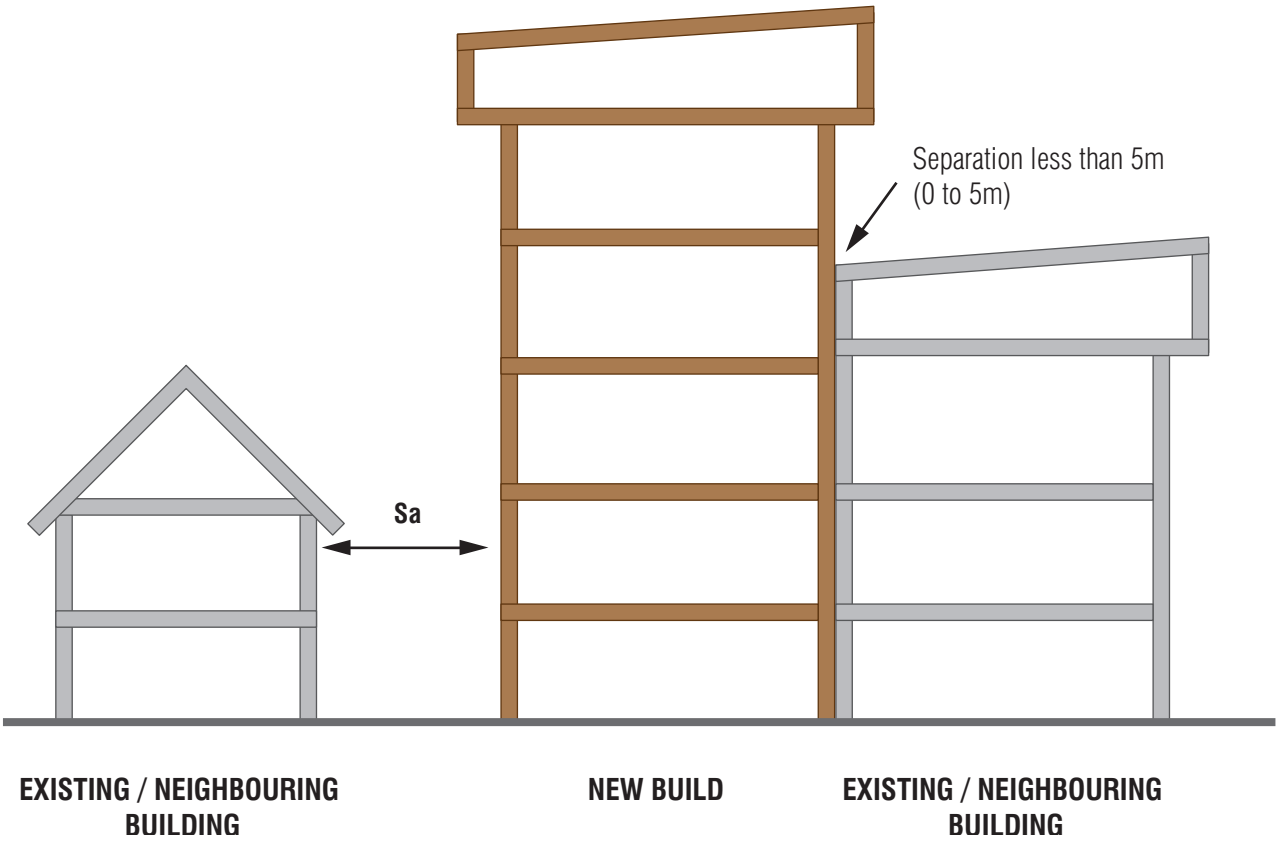


Figure 3.5 Example of extreme condition compliance: where separation distances are closer than possible using Category B and C1 (Elevation view)

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 barrier to the framing beyond this area. In this instance Category C2 frame types are required for at least the first compartment (minimum 20 metres or the building depth, whichever is the least) nearest to the boundary.

Table 4 for Category C2 - Timber frame separating distance (m)

Number of timber frame storeys	EMITTER LENGTH
	n/a
1 - 7	0

Compartmentation in Category B and C

The compartmentation within a building 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 With all the compartmentation solutions a floor with FR Build joists, rims and blocking and decking shall be used with solid blocking at the party wall / compartment wall so as to close it off and provide a continuous vertical line through the building. Minimum thickness of 75mm of blocking above the wall.

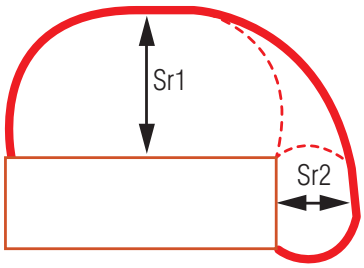
5 Openings for services and doors for access in any compartment wall to be suitable to resist fire penetration - 30 mins integrity, insulation and stability.

Combining Category B and C in a building

It is permissible to combine Category B and C frames in a building.

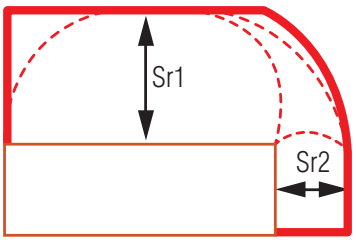
Adopting the separating distance tables for buildings at angles to the new build

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.



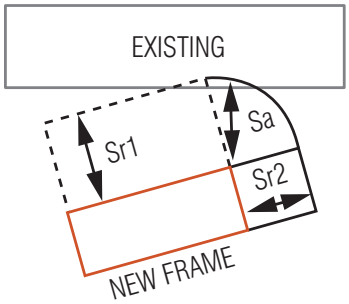
Diagrammatic theoretical profile plan view of the radiant heat flux boundary for a given building.

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.

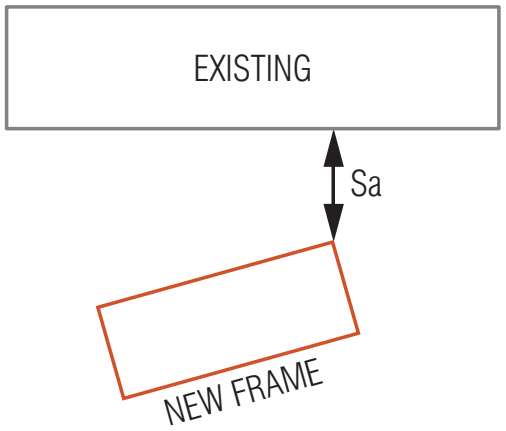


Principle applied at the junction of existing to new build.

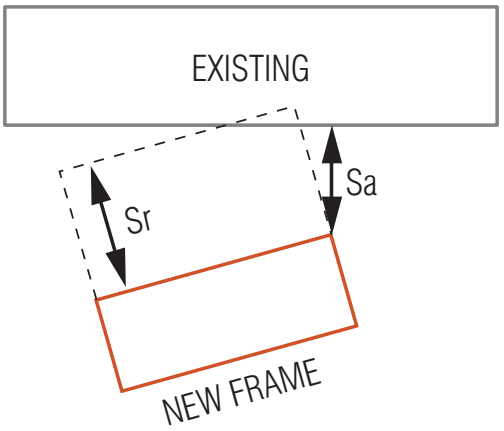
Sa is exceeded in the above example.

Figure 3.6 Buildings at angles to the emitter

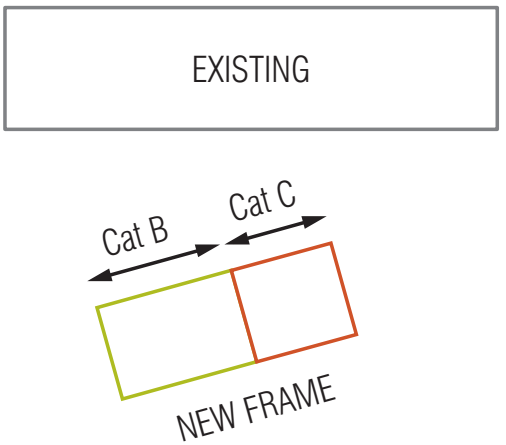
How this applies to the guidance is as follows:



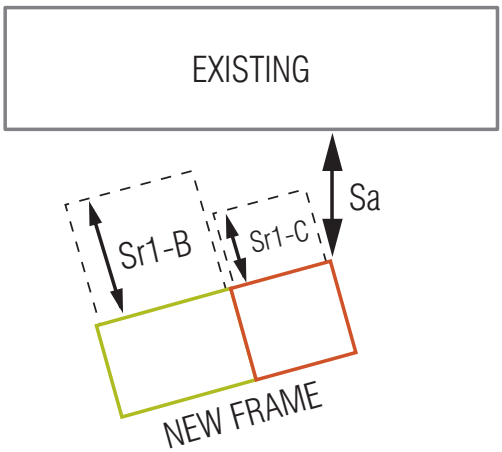
New build at an angle to the existing building.



Using the separating tables for a given emitter length the resultant separating distance Sr boundary impinges on the existing building line so Sr >Sa. 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 = Sr1-C. This provides sufficient separation from the existing building.

Sr1-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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