Timber-framed Construction for Multi-residential Buildings Class 2 & 3

Design and construction guide for BCA compliant sound and fire-rated construction

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Introduction

Fire and sound are important issues in residential construction. Sound insulation tends to govern the choice of construction system because of its daily impact on the quality of life, while fire-resisting construction is important for protecting against extreme events. This Guide aims to assist in both areas and is specifically written for use by designers, specifiers, builders, code officials and certifying authorities. It is set-out according to a simple step-by-step process shown in Figure 1. The steps are then used as the basis for headings throughout the rest of the document. Details on the scope and other important aspects of the Guide are below.

Scope

For timber-framed construction, this Guide demonstrates achievement of targeted fire- and sound-performance Requirements in the National Construction Code Series Volume 1 Building Code of Australia (BCA) for Class 2 and 3 buildings. In this context, the Guide provides certified construction details that utilise the Building Code of Australia Deemed to Satisfy Provisions. Specific areas of performance addressed include:

- sound transmission and insulation of wall, floor and ceiling elements relevant to Sole Occupancy Units and surrounding construction; and

- fire-resisting construction of wall, floor and ceiling elements relevant to Sole Occupancy Units and surrounding construction.

In addition, this Guide provides assistance for those wanting to improve and upgrade sound performance beyond minimum BCA requirements, including low frequency impact sound, vibration-induced sound and flanking noise. Evidently, these issues are beginning to dominate end-user requirements and require specific attention. This Guide does not deal with all aspects of fire safety and sound insulation. For further details on this issue refer to Appendix B – Deemed to Satisfy fire requirements not covered by this Guide.

Finally, this Guide does not provide advice on which tested wall and floor systems should be used as there are many suppliers of these systems. The Guide provides advice in many instances on how these tested systems are joined and interact while maintaining the objectives of the BCA.

Evidence of Suitability

The BCA requires every part of a building to be constructed in an appropriate manner to achieve the requirements of the BCA. This Guide is the basis of a series of three Guides that include WoodSolutions Guide 1 and 3. These three guides have similar fire resistance details and these details have been reproduced in Wood Solution Guide 6 Timber-framed Construction Sacrificial Timber Construction Joint.

WoodSolutions Guide 6 has been assessed by a Registered Testing Authority – Exova Warrington Fire Australia Pty Ltd, showing that the materials and form of construction has been submitted to the tests listed in the report, and setting out the results of those tests and any other relevant information that demonstrates its suitability for use in the building. This assessment report 22221A-00 is titled The likely fire resistance performance of various MRTFC roof and wall junctions in fire resistant wall construction if tested in accordance with AS1530.4 – 2005.

This assessment report provides the evidence for use within building regulations. If required the assessment report is available from Wood Solutions. Other information sources that support this guide are referenced in Appendix C of this guide.

Other Building System Information

This guide contains no information on tested wall, floor and ceiling systems that make up timber framed buildings. Information on these systems can be found from suppliers of building products, such as timber suppliers, lining manufacturers or associated product suppliers. Evidence of Suitability in accordance to the BCA is the responsibility of these suppliers.
Regulatory Differences Between States of Australia

This publication focuses on current BCA requirements. From time to time State-based BCA amendments may vary requirements. The user of this Guide should make themselves aware of these differences and should develop a full understanding of the resulting implications. This Guide should be used on this basis. The Guide is also based on building regulations approved in 2015.

Design process for sound- and fire-resistant timber-framed construction.

**Step 1 – High-Level BCA Design Issues**
- Determine the Class of building
- Determine the basis for complying with BCA Performance Requirements, i.e. Deemed to Satisfy Provisions to be used
- Determine the setout of Sole Occupancy Units in the building

**Step 2 – Define BCA Sound Design Requirements**
- Utilise the Deemed to Satisfy Provisions for sound transmission design
- Determine sound-insulation requirements for elements, e.g. walls, floors

**Step 3 – Improving Sound Performance**
- Attention to building design (space and form)
- Address flanking noise
- Strategies for improving sound performance

**Step 4 – Define BCA Fire Design Requirements**
- Utilise the Deemed to Satisfy Provisions for fire design
- Determine the Type of Construction required for fire-resistance
- Determine the Fire Resistance Levels of elements, e.g. walls,
- Address special fire issues, e.g. stairs, shafts

**Step 5 – Select fire/sound rated timber construction**
- Principles in fire/sound rated timber construction
- Select a fire/sound rated timber-framed system
- Detail the selected system, e.g. joints, penetrations

**Step 6 – Further design assistance (Appendices)**
- Structural considerations, other BCA requirements, references, glossary

Although national, some BCA provisions differ by state. It’s vital to know key variations for your area.
Step 1 – High-Level BCA Design Issues

The BCA is the regulatory framework for determining minimum construction requirements for all types of buildings in Australia. It contains different levels of detail that subsequently cause different levels of decisions to be made on a building project. A selection of high-level design issues relating to fire-resisting and sound-insulating construction are addressed in this section of the Guide.

1.1 Determine the Class of Building

The BCA contains mandatory Performance Requirements which apply to 10 primary classes of building. The classes are determined according to the purpose for which the building will be used. The classes relevant to this Guide are:

• **Class 2 buildings** – buildings containing two or more sole-occupancy units each being a separate dwelling e.g. apartment buildings.

• **Class 3 buildings** – a residential building which is a common place of long-term or transient living for a number of unrelated persons, including:
  – a boarding-house, guest house, hostel, lodging-house or backpackers accommodation;
  – a residential part of a hotel, motel, school, detention centre or health-care building (where accommodating members of staff); and
  – accommodation for the aged, children or people with disabilities.

1.2 BCA Compliance – Deemed to Satisfy or Alternative Solution

The BCA’s Performance Requirements can be achieved for the above building classes in two ways:

• Deemed to Satisfy Provisions – this means a specific type of construction that is acknowledged as complying with the BCA’s Performance Requirements, or

• Alternative Solutions – this means a solution not dealt with under Deemed to Satisfy Provisions and must be proven to satisfy BCA Performance Requirements. Suitable assessment methods are identified in the BCA.

The construction systems and details in this Guide comply with the Deemed to Satisfy Provisions. For instance, these provisions direct the level of fire and sound resistance that construction elements must achieve in order to meet minimum BCA requirements. Approved BCA methods of assessment are then used to ensure that the timber-framed construction systems shown in this Guide comply with the levels required.

In the event that a satisfactory timber-framed solution cannot be obtained under the Deemed to Satisfy solutions in the Guide, then an Alternative Solution is required. Alternative Solutions are not dealt within this Guide but the following Wood Solutions Guide cover the following areas.

• Timber structural components: #17 Alternative Solution Fire Compliance: Timber Structures

• Timber Facades: #18 Alternative Solution Fire Compliance: Facades

• Internal coverings: #19 Alternative Solution Fire Compliance: Linings

It is important to note that a mixture of Deemed to Satisfy Provisions and Alternative Solutions can be used to develop an acceptable solution for a building. The user does not need to follow one or the other path.
1.3 Determine the Setout of Sole Occupancy Units (SOU) in the Building

The concept of a Sole Occupancy Unit (SOU) is central to addressing many issues concerning fire and sound performance in Class 2 and 3 buildings. A SOU helps separate a given building into manageable units for dealing with fire and sound performance:

- A SOU is a room or other part of a building for occupation by an owner, leasee, tenant or other occupier, to the exclusion of others.

- SOUs must be designed to restrict fire and sound entering adjoining SOUs and certain other parts of the building.

The wall and floor/ceiling elements that bound an SOU (Figure 2) are central in achieving BCA sound and fire performance, but specific requirements vary depending on whether the SOUs are:

- side by side;
- stacked on top of each other (as well as side by side);
- adjoining rooms of a different type or space (such as a public corridor); or
- adjoining rooms of similar usage back-to-back, e.g. back-to-back habitable areas or back-to-back service rooms such as laundries or kitchens.

Note: Though bounding wall and floor elements of a SOU identify the main sound- and fire-rated elements, it is also highly likely that certain internal walls and floors will also need to be fire-rated when they are supporting fire-rated walls/floors located above.

![Figure 2: Examples of Sole Occupancy Units.](image-url)
Step 2 – Define BCA Sound-Design Requirements

In today’s building design, sound insulation tends to govern the choice of timber-framed construction more so than fire requirements. In terms of the BCA, designing sound resisting construction involves a process of understanding how Performance Requirements translate into the more objective and measurable Deemed to Satisfy Provisions, then selecting timber-framed construction systems that suit these requirements. As will be discussed in Step 3, there is a parallel need to address sound induced by poor spatial design of a building, flanking noise problems, and where appropriate, upgraded sound performance requirements to meet end user needs.

2.1 Utilising the Deemed to Satisfy Provisions for Sound Design

Part F5 of the BCA is concerned with ‘safeguarding building occupants from illness or loss of amenity as a result of excessive noise’. BCA Performance Requirements focus on the sound insulation of wall and floor elements bounding Sole Occupancy Units where separating:

- adjoining units; and
- common spaces from adjoining units.

Provisions that meet the above Performance Requirements are detailed in the BCA under section F5 which covers the airborne and impact sound-insulation ratings for walls, floors and services (Note: the provisions also include the sound isolation of pumps but issues pertaining to this are not dealt with in this Guide). In interpreting these requirements, it is important to have an understanding of the difference between airborne and impact sound (Figure 3).

**Figure 3: Examples of impact and airborne sound.**

It is also important to understand how each type of sound is measured in order to select appropriately sound-insulated wall, floor and ceiling elements. To this end, the nomenclature used in the Deemed to Satisfy Provisions using results from laboratory requirements, is explained in Figure 4 and Figure 5. NOTE: Alternative methods of sound measurement also exist.
A Ctr modification factor can be added to the Rw measurement to bias the overall measurement to take greater account of low frequency noise (bass, sub woofer). Ctr is usually a negative number with a typical range of -1 to -15, and so, even though it is added to the Rw value, the net result is a lower number than the Rw value on its own. It is therefore significantly harder to achieve Rw + Ctr 50 than Rw 50 on its own.

Applying the above involves finding out the minimum stated Rw or Rw + Ctr for a given building element (as determined using the Deemed to Satisfy Provisions) as dealt with in Section 5.2 in this guide.

Figure 4: Methods of measuring airborne sound.

Impact sound is typically measured in the Deemed to Satisfy Provisions using the Weighted Normalised Impact Sound Pressure Level expressed as L_{n,w} (e.g. L_{n,w} 62).

- It is usually applied to floor elements.
- The lower the number the better the performance.
- It can be used on its own or modified using spectrum adaption term C_l (see below).

A C_l modification factor can be added to the L_{n,w} figure to bias the overall measurement into taking greater account of low frequency impact sound such as footsteps. It is usually a positive number, and so when added to the L_{n,w} measurement, the net result is a higher number than the L_{n,w} measurement on its own. It is therefore significantly harder to achieve L_{n,w} + C_l 62 than L_{n,w} 62 on its own.

Applying the above involves finding out the maximum stated L_{n,w} or L_{n,w} + C_l for a given building element (as determined using the Deemed to Satisfy Provisions) as dealt with in Section 5.2 in this guide.

Figure 5: Measuring impact sound.
2.2 Determining Sound Insulation Requirements for Individual Building Elements

Of importance to construction is the minimum airborne and impact sound insulation requirements for individual building elements, e.g. wall (Table 1) and floor elements. Table 2 provides a simple means for finding out such information and is necessary for selecting appropriate timber-framed construction, system.

**Table 1: Deemed-to-satisfy Sound Insulation Requirements in Class 2 and 3 Buildings Walls**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Wall Rating</th>
<th>Entry Door Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Space</td>
<td>Adjoining space</td>
<td></td>
</tr>
<tr>
<td>SOU – generally all spaces except those noted below</td>
<td>Separates</td>
<td>SOU – generally all spaces except those note below</td>
</tr>
<tr>
<td>A bathroom, sanitary compartment, laundry or kitchen</td>
<td>Separates</td>
<td>SOU – habitable room¹ (except kitchen)</td>
</tr>
<tr>
<td>A bathroom, sanitary compartment, laundry or kitchen</td>
<td>Separates</td>
<td>SOU – non-habitable³ room (including kitchen)</td>
</tr>
<tr>
<td>Plant and lift shaft</td>
<td>Separates</td>
<td>SOU – all spaces</td>
</tr>
<tr>
<td>Stairway, public corridor, public lobby or the like or part of a different BCA building classification</td>
<td>Separates</td>
<td>SOU – all spaces</td>
</tr>
</tbody>
</table>

Notes:
1 Habitable room means a room used for normal domestic activities includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom;
2. Discontinuous construction refers to walls having a minimum 20 mm gap between separate leaves and with no mechanical linkages between wall leaves except at the wall periphery.
3. Non-Habitable room are bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods Refer BCA definition.

**Table 2: Deemed-to-satisfy Sound Insulation Requirements in Class 2 and 3 Buildings for floors**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Wall Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Space</td>
<td>Adjoining space</td>
</tr>
<tr>
<td>SOU – all spaces</td>
<td>Separates</td>
</tr>
<tr>
<td>Public corridor or lobby or the like</td>
<td>Separates</td>
</tr>
<tr>
<td>Stair and lift shaft</td>
<td>Separates</td>
</tr>
<tr>
<td>Plant Rooms</td>
<td>Separates</td>
</tr>
<tr>
<td>Different BCA Building Classification</td>
<td>Separates</td>
</tr>
</tbody>
</table>

Where a wall is required to have sound insulation has a floor above, the wall must continue to the underside of the floor above, or the ceiling must provide the equivalent sound insulation required for the wall. (Professional advice should be sought to upgrade ceiling to the required wall sound insulation).
2.3 Services

If a duct, soil, waste or water supply pipe serves or passes through more than one dwelling, the duct or pipe must be separated from the rooms of the dwellings by construction with an $R_w + C_r$ not less than:

- 40 if it is adjacent to living areas in a dwelling; or
- 25 if it is adjacent to a kitchen or bathroom.

It is also required where a duct or pipe is located with a wall or ceiling cavity.

2.4 The Next Step

Having used the previous information to obtain an understanding of the BCA’s minimum sound-insulation requirements, the next step is to either:

- go to Step 3 to find out about improving and/or upgrading sound performance (e.g. beyond minimum BCA requirements); or
- go to Step 5 to select timber-framed construction that will comply with minimum BCA sound requirements.

Once sound-insulation requirements are satisfied, the next Step is Step 4 Fire Design Requirements.

Refer to:
BCA F5.6.
Step 3 – Improve and Upgrade Sound Performance

Sound performance can often be improved by simple attention to the form and spatial arrangement of the building design. Attention to flanking noise represents another important means of improving sound performance. In addition, many end users of dwellings want higher sound performance than the minimum levels required in the BCA. As a result of these issues, this Step in the Guide focuses on ways to improve and upgrade sound performance.

3.1 Attention to Building Design to Reduce Sound Transmission

Aspects of the form and spatial design of a building that can be adapted to improve sound performance are dealt with under the following headings.

3.1.1 Room Layout

Check that the room layout is beneficial rather than detrimental to sound transmission. Service rooms including bathrooms, laundries and kitchens create extra sound compared to living rooms and bedrooms. For instance, water movement through plumbing pipes and the vibration from washing machines and dishwashers create sound problems. It is therefore best for the service rooms in one dwelling to back onto the same type of rooms in an adjoining dwelling (but not back onto habitable rooms such as bedrooms or loungerooms). Also, try to ensure entrances to dwellings are an appropriate distance from adjacent units (Figure 6).

3.1.2 Windows

Windows normally have lower sound insulation than the walls they are located within. As a result, highly sound-rated bounding wall systems may become ineffective by virtue of nearby poorly sound rated windows. For improvement, consider one or more of the following:

- Use thicker glass or double glazing.
- Use fixed glazing in lieu of opening windows. (This may also require sound-insulated ventilation.)
- Locate windows so that they do not face noisy areas.
- Provide adequate separation between windows in adjoining SOUs.
- Reduce the area of windows in the facade.
- Fill voids between the wall frame and window frame with an appropriate acoustic sealant.
- Use acoustic sealing strips/gaskets around the edges of open-able sashes.

3.1.3 Doors

As with windows, doors tend to be the weak link in sound rated wall systems. Where sound-control is desired, solid core doors should be used and should be treated with soft acoustic gaskets at interfaces with door jambs. Threshold closers at the bottom of the door or air seals will also reduce sound transmission. In most cases, the sound rating required to be met will require the use of gaskets and seals. Sliding doors should be avoided where optimum sound-control is desired.

3.1.4 Services

The location and detailing of services are two of the most important considerations in controlling sound transmission in residential buildings.

Generally, services and service penetrations should not be located on sound-insulated walls between SOUs but rather on internal walls or dedicated sound resistant service shafts. In all instances, service pipes should be located away from noise sensitive parts of the dwelling such as bedrooms (Figure 6).
3.2 Addressing Flanking Noise

The ability to insulate against sound moving from one dwelling to the next is dependent not only on insulating individual wall and floor elements, but also on stopping noise from jumping or transferring from one building element to the next, or worse still, moving through the building in an uncontrolled way. As a result, the effectiveness of sound-insulated construction is concurrently dependent on addressing flanking noise. Flanking noise refers to sound passing around rather than through wall/ floor elements, thus causing sound to unexpectedly manifest itself in unwanted places.

The main flanking routes around wall and floor elements are shown in Figure 7. These routes particularly apply to walls and floors separating SOUs but may also apply to external walls and in some instances internal walls (within SOUs) as well.

Figure 6: Good and bad sound design practices in building layout – plan view.

3.1.5 External Walls

There are no BCA requirements for sound ratings of external walls, but in some parts of Australia there may be state planning regulations or local government requirements for external wall sound rating. For information on the sound performance of common timber framed external walls, refer to Wood Solutions Guide No 11 Timber-Framed system for External Noise.
There are no minimum requirements addressing flanking noise in the BCA’s Deemed to Satisfy Provisions, though there is an onus on designers and builders to address flanking noise in order to ensure that laboratory-tested wall and floor elements perform to their full potential in the field.

In developing this Guide consideration was given to reducing the flanking noise paths wherever possible. In some instances, limits on what could be achieved in reducing flanking were imposed because of their affect on fire and structural integrity. Therefore details given in this Guide are the conclusion of careful thought, taking into account all these issues. Even though direct reference to reducing flanking noise has not been made, many of the details incorporate elements within them.

An example of reducing flanking noise can be seen in the standard detail for floor joist and flooring over bounding walls where the joist and flooring are not continuous. This has been done purely to reduce flanking noise and has no other purpose (Figure 8).

**Figure 7: Flanking and airborne noise pathways – elevation view.**

**Figure 8: Discontinuous floor joist and floor sheeting – elevation view.**
There are two main approaches used for addressing flanking noise in timber-framed buildings:

- Limit the noise getting into wall/floor element e.g. carpet, floating floors (Figure 9).
- Limit the ability of the noise to migrate from one element to another e.g. dampening and isolation at junctions between elements (Figure 8).

In addition to the strategies above, timber-framed construction details orientated to improving flanking sound are provided in Section 5.3, and include:

- platform flooring discontinuous over double stud walls;
- cavities within sound rated elements blocked or travel path increased to reduce noise;
- discontinuous elements at walls, floors and ceilings; and
- introduced isolating elements, e.g. resilient mats or brackets.

### 3.3 Strategies for Upgrading Sound Performance in Construction

Building occupants often want higher sound performance than the minimum requirements in the BCA. This is especially the case for impact sound and the related issue of vibration which comes from footsteps, water movement through pipes, water hammer and any source of vibration including washing machines, air conditioning units and dishwashers. Other scenarios not dealt with in the BCA include acoustic requirements for home entertainment areas, noise transfer within a dwelling and noise from outside the building (e.g. busy roads, trains, aircraft noise). Options for upgrading typical construction are provided below. Using a combination of options is more likely to give best performance.

**Isolating one side of a bounding construction from the other** (e.g. using double stud cavity wall construction). This is also known as decoupling and can be useful in reducing both airborne and impact sound. Of note, it serves to limit noise vibration from one side of the element to the other.

**Avoiding rigid connections between the opposing sides of isolated (decoupled) elements.** This limits the occurrence of sound bridges that would otherwise allow sound to transmit from one side to the other. If required for structural stability, sound-resilient connectors should be used and should generally only be used at floor or ceiling level.

**Using absorptive materials to fill wall and floor cavities** (cellulose fibre, glass fibre or mineral wool) can reduce airborne sound transmission.

**Sealing sound leaks** at the periphery of wall and floor elements or where penetrations are made for electrical and plumbing services.

For information for the upgrade of external walls refer to WoodSolutions Guide #11 - Timber Framed Systems for External Noise.
3.3.1 Walls

Extra mass on the walls – the addition of mass is a simple yet important means of improving sound performance in timber-framed construction. In its simplest form, this involves adding extra layers of material such as plasterboard to the outer layer of the sound rated wall system.

Use a 90 mm rather than 70 mm wall studs – The wider the wall, the better its sound performance. This is particularly the case where trying to improve $C_n$ scores (being the modification factor for low frequency bass noise applied to $R_w$ scores). The simplest means of doing this is to use 90 mm wide studs instead of 70 mm wide studs in a double stud wall system.

Upgrade batts in the wall/floor – There are many different types and grades of insulation batts available in the market place. Sound insulation specific batts are best and in addition, high density materials tend to outperform low density materials. Reference should always be made to the supplier’s documented systems recommendations as some systems require insulation or linings to affect different frequencies and therefore may have differing advice.

3.3.2 Floors

Extra mass on the ceilings – the addition of mass is a simple yet important means of improving sound performance in timber-framed construction. At its simplest manifestation, this involves adding extra layers of material such as plasterboard to the sound rated ceiling system.

3.4 The Next Step

The strategies and methods shown in this Step of the Guide may involve specialist proprietary systems that go beyond the scope of this publication. As a result, the next step is to either:

- go to proprietary system suppliers and ask for advice on how to integrate their systems with those discussed in this Guide. As part of this, care must be taken to ensure that the fire and sound performance of systems in this Guide are not compromised in any way;
- go to Step 4 to find out about fire-resisting construction requirements so that these requirements can be considered in tandem with sound requirements before selecting the appropriate timber-framed construction in Step 5; or
- go to Step 5 to select timber-framed construction that will comply with minimum BCA sound and fire requirements.
Step 4 – Define BCA Fire-Design Requirements

Designing fire-resistant construction involves a process of understanding how the BCA’s Performance Requirements translate into the more objective and measurable Deemed to Satisfy Provisions, then selecting timber-framed construction systems that suits these requirements.

4.1 Utilising the Deemed to Satisfy Provisions for Fire Design

Part C of the BCA Performance Requirements are concerned with safeguarding people when a fire in a building occurs. Specific attention is given to evacuating occupants, facilitating the activities of emergency services personnel, avoiding the spread of fire between buildings, and protecting other property from physical damage caused by structural failure of the building as a result of fire.

Deemed to Satisfy Provisions that meet the above Performance Requirements are detailed in the BCA under:

- Part C1 – Fire-resistance and stability.
- Part C2 – Compartmentalisation and separation.
- Part C3 – Protection of openings.

These Parts deal with a wide range of issues but it is only the fire-resistance of specific building elements (e.g. wall and floor/ceiling elements) that are dealt with in this Guide, as these elements can be of timber-framed construction. To this end, only relevant clauses from Parts C1, C2 and C3 are discussed in more detail below. To help users understand the full range of issues contained in these Parts, a checklist is provided in Appendix B.

4.2 Determining the Type of Construction Required

Given the previous discussion, the main issue of interest for timber-framed construction relates to determining the Type of Construction, as defined in the BCA, required to resist fire for a given building. The issues involved are described below:

- Calculate the number of ‘rise in storeys’ of the building (Note: This is a BCA term and reference to BCA C1.2 is recommended)
- Take into account concessions for two storey Class 2 and 3 buildings. Relevant factors include disregarding non-combustible requirements, number of building exits, access to open space and the use of sprinkler systems (BCA C1.5).
- Determine if the construction is Type A, B or C construction (BCA C1.1):
  - Type A provides the highest level of passive protection e.g. structural elements must withstand burnout of the building contents.
  - Type B provides lower passive protection e.g. less of the structure must be able to withstand burnout of the contents.
  - Type C provides the lowest passive fire-resistance e.g. only some elements have specified fire-resistance intended to mainly restrict horizontal spread of fire to adjoining dwellings.

A chart to assist selection of the appropriate type of construction is shown in Figure 10. It also allows users to determine if a timber-framed building solution is possible under the Deemed to Satisfy Provisions, or if an Alternative Solution will be necessary.
Flats and apartment buildings containing 2 or more dwellings

Units side-by-side (no common shared area)

Units maybe side-by-side above or below each other, share common spaces or a combination of all the above

BCA DTS Spec C1.1 Clause 4.3

Units maybe side-by-side above or below each other, share common spaces or a combination of all the above

BCA DTS Spec C1.1 Clause 3.10

Requires an alternative solution. Refer to WS Guide #17

Units side-by-side

Units maybe side-by-side above or below each other, share common spaces or a combination of all the above

Units side-by-side (no common shared area)

Each dwelling provided with egress in two directions or own direct access to road or open space

One shared exit

One shared exit

One shared exit and ground floor storey is for the use as a garage and is constructed from concrete or masonry

Class 1 Building. Not covered by this Guide. Refer to WoodSolutions Guide #1

Class 2 Buildings

Class 3 Buildings

Number of Storeys

1

2

3

4

5 or above

Exits or Garage

Type of Construction

Type C

Type B

Type A

Type A

BCA Clause allowing timber construction

BCA DTS Provision C1.5 an Spec C1.1 Clause 5.0

BCA DTS Spec C1.1 Clause 4.3

BCA DTS Spec C1.1 Clause 3.10

Requires an alternative solution. Refer to WS Guide #17

Figure 10: Determine the BCA’s type of construction and applicable Deemed to Satisfying Provision.

4.3 Determining Fire Resistance Levels for Building Elements

Having determined the correct Type of Construction for the building, it is now possible to determine the Fire Resistance Levels required for various wall, floor, ceiling and other building elements (Note: This is possible using specification C1.1 as called up in the BCA’s Deemed to Satisfy Provisions).

A Fire Resistance Level (FRL) expresses the minimum amount of time (in minutes) that a building component must resist a fire as defined by three separate elements:

- Structural adequacy – ability to withstand loads.
- Integrity – in terms of containing smoke, flames and gases.
- Insulation – in terms of limiting the temperature on one side of the element getting through to the other side.

An example of the way that a Fire Resistance Level is expressed is: 60/60/60. Another example where a fire rating is not required for all elements is: – /60/ –.
Deemed to Satisfy Fire Resistance Levels for building elements in Class 2 and 3, Type A, B and C construction are provided in Figures 11, 12 and 13 respectively. Class 9c. These figures represent an interpreted version of information contained in BCA Specification C1.1. In interpreting these figures care should be taken to recognise the variety of different wall, floor and ceiling situations involved. Of note, this includes the selective need for roof void walls that restrict the passage of fire from one SOU to another through the roof void. An alternative which is relevant to Type A construction is the use of a Resistant to Incipient Spread of Flame ceiling which aims to prevent the spread of flame before it gets into the roof void.

Once relevant Fire Resistance Levels have been established for all relevant elements it is then possible to select timber-framed construction that will meet the chosen Fire Resistance Levels requirements from Section 5. In addition, it is important to consider more specialised elements as dealt with under the following Section 5.4.

**Figure 11a: Type A Construction Deemed to Satisfy Requirements – without sprinklers (must have smoke alarms).**

**Figure 11b: Type A Construction Deemed to Satisfy Requirements – with sprinklers and smoke alarms.**
Figure 12a: Type B Construction Deemed to Satisfy Requirements – without sprinklers (must have smoke alarms).

Figure 12b: Type B Construction Deemed to Satisfy Requirements – with sprinklers and smoke alarms.
**4.3.1 Non-Combustibility Concession**

The BCA Specification C1.1 for Type A and B construction requires that external walls, common and non-loadbearing fire-resisting wall and shafts to be built from non-combustible material and loadbearing internal and fire walls to be built from concrete or masonry. Specification C1.1 Clause 3.10 and 4.3 provides a concession to these requirements as long as non-combustible insulation is used. Non-combustible insulation products are mainly mineral wool products but confirmation is required from the manufacturer.

**4.3.2 Sprinklers**

There is no requirement to use sprinklers in Class 2 and 3 buildings as long as the effective height of the building is not more than 25 m. If sprinklers are installed, there is a concessions for Type A and B Fire Resistance Level for certain elements.

**4.4 Special Fire Issues**

In constructing Class 2 and 3 timber-framed buildings, special issues arise as buildings become larger and more complicated. Although this Guide does not attempt to provide information to suit all circumstances, information is provided where there is relevance to timber-framed construction practices. A summary of fire issues covered in this Guide is found in Appendix B.

**4.4.1 Smoke–Proof Walls**

For Class 2 and 3 buildings, the BCA requires that public corridors greater than 40 m long be divided by smoke-proof walls at intervals of not more than 40 m. These walls must be built from non-combustible materials and extend to the floor above, roof covering or Resistant to Incipient Spread of Fire ceiling.

Details showing how to construct smoke-proof walls out of timber-framed construction are shown later in this Guide under Section 5.10.
4.4.2 Shafts

Shafts used in Type A buildings for lifts, ventilation, pipes, garbage or similar purpose are required to be fire-resisting to a Fire Resistance Levels of 90/90/90 or -/-90/90. For Type B & C buildings, shafts should have the same Fire Resistance Levels as the element they penetrate.

Shafts must also be enclosed at the top and the bottom with a floor/ceiling system of the same Fire Resistance Levels as the walls, except where the top of the shaft is extended beyond the roof, or the bottom of the shaft is laid on the ground.

The shaft is also required to be sound rated if it passes through more than one SOU and must have a $R_w + C_r$ of 40 if the adjacent room is habitable and $R_w + C_r$ of 25 if it is kitchen or non-habitable room.

Details showing how to construct shafts in timber-framed construction are shown later in this Guide under Section 5.6.

4.4.3 Fires during the building’s Construction

Fires may occur on building construction sites due to the nature of the works such as the (cutting and welding) result of hot work, heating equipment or accidental fires. Sometimes malicious arson maybe the cause.

Timber framed construction covered with fire protective linings is a very safe and economical buildings system. The addition of the fire rated linings plays an important role in providing this fire safety and due to the construction sequencing, fire rated timber framed building construction may have a period of time where the timber framed is not lined with fire rated linings. During this period timber buildings are at their highest risk from construction fires.

The BCA requires a suitable means of fire-fighting must be installed in a building under construction to allow initial fire attack by construction workers and for the fire brigade. The BCA specifies that a building under construction which is less than 12 m in height must have one fire extinguisher to suit Class A, B and C fires and electrical fires be provided at all times on each storey adjacent to each exit or temporary stairway or exit.

As the BCA only prescribes minimum levels of compliance, builders and building owners should consider what is actually required for the building site. Wood Solutions Guide No 20 Fire Precautions During Construction of Large Buildings provides additional information that applies to the design and planning stages as well as the actual construction phase.

4.4.4 Complex Roof Framing Intersecting Fire-Rated Walls

Where a roof void may allow a fire to pass from one SOU to another, the BCA requires that a fire-resisting wall extend to the underside of a non-combustible roof and not to be crossed by combustible construction except for a maximum of 75 x 50 mm roof battens. For many situations this is not practical such as where walls intersect valleys or hips ends. In these cases, a ceiling which is Resistant to Incipient Spread of Fire is often a preferred option, see Section 5.5 of this Guide.

Refer to:
BCA Spec C3.1(c) and C4.1 (d).
4.4.5 Vertical Separation of Openings in External Walls

To reduce the chance of a fire spreading from one floor to the next via the external wall, there is a need in the BCA to address the vertical separation of openings. This only applies to Type A construction, as there is no requirement for Type B and C construction.

In Type A construction, where there is an opening directly or within 450 mm (measured horizontally) of another opening in the storey below, and the building is not fitted with automatic sprinklers, the BCA requires these openings to be protected (Figure 15).

Protection can be achieved by a spandrel which is not less than 900 mm in height between the two openings and not less than 600 mm above the upper floor surface. The spandrel must have a Fire Resistance Level of 60/60/60, which in most cases is the requirement of the external wall.

Alternatively, horizontal construction projecting at least 1,100 mm from the external face of the wall and extending not less than 450 mm beyond the opening, either side of the wall, is required. Again the construction must have an Fire Resistance Levels of 60/60/60.

Details showing how to construct the two options in timber-framed construction are given in this Guide under Section 5.7.

Construction should also be given to installing complying sprinklers as they remove the need for spandrel panels. Sprinklers also have other benefits such as reducing FRL for internal walls and floors.
4.4.6 Fire - and Non-Fire-Isolated Stairs and ramps used as the buildings required exist

Stairs used as exits in buildings are important to allow people to travel past a storey on fire and to enable fire brigade personnel to carry out search and rescue and fire-fighting.

The BCA sets out construction requirements for two types of stairs termed fire isolated and non-fire isolated and their use is dependent on the building classification and how many storeys the stair or ramp has to go through.

For Class 2 and 3 buildings the BCA required only the stairway or ramp used as the required exit to be fire-isolated if it’s passes through or passes by more than:

- Class 2 building - 3 consecutive storeys
- Class 3 building - 2 consecutive storeys

One extra storey is allowed for each building classification if one of the following is present:

- the storeys is only for motor vehicle accommodation,
- the entire building has a complying sprinkler system to BCA specification E1.5
- the stair or ramp by passes the extra storey i.e. no access or egress, and is separated from the extra storey by construction that is loadbearing 90/90/90 and non-loadbearing - /60/60 and no opening is present to allow the passage of smoke or fire.

Stair or ramps that are required exits and do not pass through or by the maximum storey for each building classification allowed from above are termed non-fire isolated. As this Guide addresses a maximum rise in storey of 3 or 4 if the lowest storey is a car park, for Class 2 construction, non-fire isolated stairs are sufficient. For Class 3 buildings there maybe situations that a fire isolated stairs is required.

Construction details for Fire isolated and Non-fire isolated stair or ramps are discussed later in this Guide under Section 5.8.

4.4.7 Services Penetrating Fire-Resistant Elements

The BCA requires that where services such as pipes, ducts and electrical cables that penetrate a fire-rated wall, floor or ceiling, such penetration must not affect the performance of the building element.

Details showing how to meet this requirement are shown later in Section 5.6.

4.4.8 Lightweight Construction

The BCA requires elements that have a Fire Resistance Levels, or that form a lift, stair shaft, an external wall bounding a public corridor, non-fire-isolated stairway or ramp, to comply with Specification C1.8, if they are made out of lightweight materials such as timber framing and plasterboard as lightweight construction can be more susceptible to damage. Specification C1.8 is a structural test for lightweight construction, and in most parts is directly related to the performance of the linings used. Manufacturers of lining material should be able to provide appropriate information on compliance to this requirement.

4.5 The Next Step

Having used this information to obtain a strong understanding of fire-resistant construction, the next step is to go to Step 5 – Selecting Timber-Framed Construction that will comply with minimum BCA fire-resisting construction requirements.
Step 5 – Select Sound - and Fire-Rated Timber Construction Systems

This Step focuses on matching Deemed to Satisfy sound-insulation levels ($R_W + C_{tr}, L_{n,w}$), Fire Resistance Levels (FRLs) and other necessary requirements with appropriate timber-framed construction. The commentary begins by explaining key principles used in timber-framed construction to address sound insulation and fire safety needs. These principles are then presented in the form of integrated systems, e.g. timber-framed wall, floor and ceiling systems. Importantly, construction details are provided for each system in terms of fire/sound rated junctions between elements, penetrations in elements, stair construction details, treatment of service shafts, balconies and similar situations.

5.1 Principles for Achieving Fire Resistance Levels in Timber-Framed Construction

Fire-grade linings (see Appendix D for definition) provide the primary source of protection to timber framing, and generally the greater the number of layers, the greater the resistance to fire. Additional measures, as discussed in the following paragraphs, are required at weak spots or breaks in the fire-grade linings that occur at intersections between wall, floor and ceiling elements. Corner laps and exposed edges in lining sheets present areas where attention is needed. Extra consideration is also needed at penetrations, openings and protrusions.

5.1.1 Timber blocks used to replace fire-grade linings

Due to the sequencing of trades in lightweight buildings, it is not always possible to provide complete covering with the fire-grade linings as framing elements often get in the way. Solid timber can be used as an equivalent to fire-grade linings in these situations and this is mainly used where linings stop at junctions between wall and/or floor elements. At these junctions, the width of the timber framework is unprotected by the linings and so extra studs, plates or joists are used to provide fire-resistance. This is possible because timber of a certain thickness forms an insulating char layer as it burns. This helps protect and slow the burning process for the remaining timber thickness. As a result, it is possible to predictably calculate and determine how long the timber joint will last in a fire. Though this varies according to timber density, in general, the more pieces of solid timber added to the joint, the longer the joint will last. For higher fire-resistance, the joint is reinforced with a light-gauge metal angle.

Common locations where solid-timber blocks are used are where building elements that are not fire-rated, or are a lower fire-resistance, intersect with fire-rated elements. These locations include wall, floor, ceilings and roof junctions. Figure 16 shows generally locations where timber blocks can be used. It is important that the extra timber block should not also have a structural propose unless shown otherwise. If the element is required to support load then these timber blocks are in addition to timber work required for structural adequacy.
Fire stops are fire-grade materials used to close gaps in the construction that occur between fire-grade materials and at service penetrations. They restrict heat, smoke and gases from moving beyond a certain point in the construction. There are various situations where such gaps occur, and so various options can be used to act as fire stop materials, including:

- fire-resisting mineral wool (Figure 16); and
- fire-resisting sealant (Figure 17).

_Figure 15: Common locations where solid-timber blocks are used to maintain fire-resistance._

_Figure 16: Fire-resistant mineral wool used as a fire stop._
5.1.2 Cavity Barriers

Cavity barriers help restrict the passage of heat, smoke and gasses where a cavity in the construction creates an unintentional passage for fire to bypass fire-rated wall or floor elements bounding Sole Occupancy Units. Cavity barriers are non-mandatory construction in so far as not directly achieving Fire Resistance Levels in wall, floor and ceiling elements. Even so, these barriers have a clear and worthwhile purpose as they also assist in reducing flanking noise as their position in wall cavities also reduces air borne noise travelling along these cavities.

Key locations are shown in Figure 18 and are described further below:

- **Situation 1:** A barrier is required where the cavity in a brick veneer wall creates the means for a fire to bypass the fire-resisting wall bounding a SOU, refer to Section 5.11 for construction information.

- **Situation 2:** A barrier is required where the cavity in a multi-storey wall creates the means for a fire to bypass the fire-resisting floor bounding a SOU, refer to Section 5.11 for construction information.

Figure 18: Key locations for cavity barriers.
5.2 Principles for Achieving Sound Insulation in Timber-Framed Construction

In timber-framed construction, airborne and impact sound requirements are primarily achieved using one or more of the following principles:

- **Increasing mass such as increasing the thickness of wall linings.** This can be particularly useful in reducing airborne sound transmission. For instance, like fire-grade linings, the greater the number of layers, the greater the increase in $R_w$ (Note: extra factors are involved in increasing $R_w+C_{tr}$).

- **Isolating one side of a wall from the other** (e.g. using double stud cavity wall construction). This is also known as decoupling and can be useful in reducing both airborne and impact sound. Of note, it serves to limit noise vibration from one side of the element to the other.

- **Avoiding rigid connections between the opposing sides of isolated (decoupled) elements.** This limits the occurrence of sound bridges that would otherwise allow sound to transmit from one side to the other. If required for structural stability, sound-resilient connectors should be used and should generally only be used at changes in floor level.

- **Using absorptive materials to fill wall and floor cavities** (glass fibre or mineral wall) can reduce airborne sound transmission. Note the BCA requires absorptive material to be no-combustible.

- **Sealing sound leaks** at the periphery of wall and floor elements or where penetrations are made for electrical and plumbing services.

- **Batten out walls in wet area.** In wet area construction, fire/sound rated walls can be compromised where bath and shower base units need to be recessed into the wall. A simple means of dealing with this is to batten out the wall (after fire/sound resisting linings have been applied) and then provide an additional lining over the top. The bath can then be installed into the batten space without affecting the fire- and sound-rated wall. In such instances, it is best to have at least 35 mm batten space and to place insulation into the cavity.

![Figure 19: Batten detail for wet area walls – elevation view.](image-url)
5.2.1 Floors Systems

Floor joists parallel to sound rated wall. By running floor joists parallel rather than perpendicular to the sound rated wall, the ability of impact sound from the floor being transferred across the wall to the adjoining SOU is less (Figure 20).

![Figure 20: Joists running parallel to bounding wall – elevation view.](image)

Upgrade sound-resilient ceiling mounts. Ceiling mounts are commonly used to prevent noise that gets into the floor from coming out through the ceiling below. They help reduce sound transfer between the bottom of the floor joist and the ceiling lining. To improve performance, some ceiling mounts now provide an isolating and damping effect. They typically force the sound energy through a rubber component which deforms slightly under load, as the sound passes from the joist to ceiling sheet. Therefore, sound-resilient mounts are not all the same, different systems have different performance and investigation is recommended (Figure 21).

![Figure 21: Upgraded sound-resilient ceiling mounts – elevation view.](image)

Increase mass of the top layer of floor systems. Increasing the mass of the top surface of the acoustic floor system is one of the best ways to improve acoustic performance. There are three common ways – concrete topping, sand or additional floor sheets.

Quantifying the improvement is difficult as the acoustic performance is aimed at improving the low frequency performance of the floor, a phenomena not measured by tested systems. It is suggested that the base floor system be designed to comply with the BCA’s sound requirements, and the additional floor mass is extra.

When height is added to a floor, consideration of the effect this has on other issues (such as wet areas, corridors, stairs, doors and windows) is needed at the planning stage.
Sand used to increase mass in timber floors. This increases the mass of the upper layer of the floor element. The air spaces between the sand particles help to reduce the vibration and energy created by impact sound from footfall.

Typically, this is achieved by placing 45 mm battens directly over a normal acoustic floor system at typical 450 or 600 mm centres (dependent on floor sheet spanning capacity). A dry sand layer, or dry sand mixed with sawdust is placed between the battens and leveled just below the surface of the final floor sheet. The final floor sheet is fixed in the normal manner, and floor covering placed on this (Figure 22).

Figure 22: Adding mass to floor system through the use of sand top layer.

Concrete topping. This increases the sound performance of the floor system, and typically can be achieved with a 35 to 45 mm thick layer of concrete placed over an isolating acoustic mat. Care is required to turn-up the isolating acoustic mat at the perimeter of the topping adjacent to the wall, otherwise the affect of the topping is negated (Figure 23).

Figure 23: Adding mass to floor system through the use of concrete topping.
**Extra sheet flooring.** This method utilises standard sheet flooring on an isolating mat. This system does not perform as well as the higher mass products, sand or concrete (Figure 24).

![Diagram of extra sheet flooring](image)

*Figure 24: Adding mass to floor system through the use of additional floor sheets.*

**Separate floor and ceiling frame.** By having two sets of joists (separate floor and ceiling joists) which are nested between but not touching each other, it is possible to isolate the two structures, thereby minimising the transference of impact sound through the structure. Even so, care must be taken with this approach to prevent flanking noise running along the floor joists and into the walls below. This can be improved by sitting the ceiling joists onto strips of isolating mat (Figure 25).

![Diagram of separate floor and ceiling frame](image)

*Figure 25: Separate ceiling and floor joist structures.*
**Isolated support for stairs.** Impact sound from stair usage typically vibrates its way into walls dividing SOUs, thus creating a greater likelihood of sound passing across the walls and into adjacent SOUs. The best way to prevent this is by isolating the support for the stair structure. Options include:

- Using the stringers to support the stairs (top and bottom) rather than the wall between dwellings (Figure 26).
- Using newell posts to support the stair structure rather than the wall between dwellings.

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**Figure 26: Isolated support for stairs – elevation view.**
5.3 Sound- and Fire-Rated Wall Construction Systems

Timber framed construction can be described in terms of the systems as depicted by the main wall, floor and ceiling elements (Figure 27).

As explained previously, all the elements shown in Figure 28 rely on multiple layers of linings to attain to fire-resistance and sound-insulation levels. Sound-absorptive insulation is also critical in the achievement of sound insulation. Further detail on each individual element in the system is discussed below.

**Situation 1:** Sound- and fire-resistant double stud wall (Figure 28) mainly used between Sole Occupancy Units (SOUs).

**Figure 27:** Main elements that make up a fire- and sound-rated timber-framed building - Elevation view

**Figure 28:** Fire- and sound-rated double stud timber wall – plan view.
**Situation 2:** Fire-resistant internal single stud wall (Figure 29) mainly used for supporting fire-rated floors and have no sound resisting requirements.

![Figure 29: Fire-rated internal timber stud wall – plan view.](image)

**Situation 3:** Fire-resistant external single stud clad wall (Figure 30) used where required to protect against an external fire source, using lightweight wall cladding.

![Figure 30: Fire-rated external timber stud wall – plan view.](image)

**Situation 4:** Fire-resistant brick veneer external wall (Figure 31) used where required to protect against an external fire source.

![Figure 31: Fire-rated brick veneer wall – plan view.](image)

**Situation 5:** Sound- and fire-resistant deep joisted floor (Figure 32) mainly used between SOUs stacked on top of each other.

![Figure 32: Fire- and sound-rated timber-framed floor – elevation view.](image)

Multiple layers + bulk insulation = good sound and fire performance.
Situation 6: Smoke walls (Figure 33) mainly used for long public corridors in Class 2 & 3 buildings.

Figure 33: Smoke walls constructed out of fire-grade linings (only) – elevation view.

5.4 Construction Joints

The BCA C3.16 requires construction joints, spaces and the like in between building elements required to be fire-resisting, to have the same Fire Resistance Level as the system it is in. These gaps often occur between fire-grade materials due to sequencing of trades as well as locations of service penetrations. A number of solutions are available, including:

- Fire-resisting mineral wool (Figure 34)
- Solid-timber blocking (Figure 34)
- Fire-grade sealant (Figure 35)
- or a combination of all the above.

Figure 34: Fire-resistant mineral wool used to close a gap – plan view.
5.4.1 Solid Timber Construction Joints

Solid timber can be used as an equivalent to fire-grade linings mainly where linings stop at junctions between wall and/or floor elements. At these junctions, the width of the timber framework is unprotected by the linings and so extra studs, plates or joists are used to provide the required fire-resistance. This is possible because timber of a certain thickness forms an insulating char layer as it burns. This helps protect and slows the burning process for the remaining timber thickness. As a result, it is possible to predictably calculate and determine how long the timber joint will last in a fire. Though, this varies according to timber density and species, in general, the more pieces of solid timber added to the joint, the longer the joint will last. Solid timber blocks can be any species or engineered timber, not required to have a stress grade, but must have a density of 450 kg/m$^3$ or greater. Refer to Figure 36 for a general illustration of a 60 minutes fire-resisting system. The example shown is a non-fire-rated wall abutting a fire-rated wall. Other applications are discussed later in the Guide.

Figure 35: Fire-resistant sealant used to close a gap.

Figure 36: Non-fire-rated wall abutting 60 minute fire-rated walls using timber blocks – plan view.

For 90 minutes fire-resisting systems the fire-grade plasterboard adjacent to the timber blocks is required to be support by thin gauge metal angles, 35 x 35 x 0.7 mm BMT (Figure 37).

Figure 37: Timber sacrificial blocks used to close a gap for a 90 minute system – plan view.

The system is limited to fire-resistance of 90 minutes. Where fire-resistance greater than 90 minutes is required, continuous fire-rated linings through the wall junction is recommended.
5.4.2 Common Locations for Construction Joints

Due to the number of building classifications and types of construction covered by this Guide, there are a variety of situations when wall and floor elements may require the maintenance of the fire and sound rating. It can be simplified to the following three situations where:

- Non-fire-rated wall or floor element abuts a fire-rated wall or floor element, refer Section 5.4.3 in this Guide.
- Fire-rated walls and floor elements abut, both have Fire Resistance Levels but one is lower than the other, refer to Section 5.4.4 in this Guide.
- Fire-rated wall and floor elements abut but have the same Fire Resistance Level, refer to Section 5.4.5 in the Guide.

As explained in Section 5.1, solid timber is used as an equivalent to fire-grade linings, the more blocks the greater the Fire Resistance Level achieved. This is an important means of making fire-resisting joints between wall, floor and ceiling elements in timber-framed construction and is a principle that can be used for situations not covered by this Guide.

Such joints are generally only required where there is a break in the fire-grade lining and this generally excludes situations where two of the same Fire Resistance Level elements intersect. Instead, the emphasis is on junctions between non-fire-rated elements meeting fire-rated elements, or, lower fire-rated elements meeting more highly fire-rated elements. The systems described later do vary depending on the fire-resistance required. Generally this difference is that timber blocks alone only work for 60 minutes while 90 minutes system requires 2 x 45 mm thick timber blocks as well as reinforcing with a metal angle or flashing.

5.4.3 Junctions Between Non-Rated and Fire-Rated Elements

As previously mentioned, the fire-grade linings provide much of the fire resistance developed in timber-framed fire-rated building systems. Due to the construction sequencing of a typical timber-framed building the fire-grade linings are normally affixed well into the building’s construction schedule. Therefore this leaves many possibilities for elements within a building to interfere with the placement of the fire-grade linings. Locations where this could occur are:

- Non-fire-rated walls abutting fire- and sound-rated walls,
- Non-fire-rated walls abutting a fire-rated wall,
- Non-fire-rated internal walls meeting a fire-rated ceiling or floor,
- Roof framing elements supported off fire-rated walls,
- Internal non-fire-rated floors abutting fire-rated walls,

Non-Fire-Rated Walls Abutting Fire- and Sound-Rated Walls

There are two ways to provide fire safety (Figures 38 and 39). The system shown in Figure 39 is dependent on solid-timber blocks replacing the fire-resistant linings. The important point is that the addition of the timber blocks is supplementary to the framing required for structural purposes. This system is limited to FRL 60 minutes, and requires the addition of 1 x 45 mm block or 2 x 35 mm blocks.

While solid wood blocks can add fire safety, they must be supplementary to structural framing.
Systems with an FRL of 90 minutes require the use of 0.7 mm BMT light-gauge metal angle to reinforce the joint (Figure 39). This is in addition to the 2 x 45 mm solid-timber blocks which are also required.

![Figure 39: Non-rated wall abutting a fire- and sound-rated wall using metal angles – FRL 90 minutes – plan view.](image_url)

**Non-Fire-Rated Walls Abutting Fire-Rated Walls**

This situation occurs normally within a unit or where there is no sound rating required. Again the principle is the same, where the fire-resistant linings cannot be placed, solid-timber blocks can substitute for the linings. The technique to deal with them is similar to section 5.4.3.1 (Figure 40). This system is limited to 60 minutes and requires 1 x 45 mm or 2 x 35 mm timber blocks.

![Figure 40: Non-rated wall abutting fire-rated wall using timber blocks – FRL 60 minutes – plan view.](image_url)

Again for an FRL of 90 minutes, light gauge metal angles and 2 x 45 mm timber blocks are required (Figure 41).

![Figure 41: Non-rated wall abutting fire-rated wall using timber blocks and 35 mm metal angle – FRL 90 minute – plan view.](image_url)

Light gauge metal angles do more than reinforce joints.
Non-Fire-Rated Internal Walls Meeting Fire-Rated Ceiling or Floor

Where internal non-loadbearing walls meet fire-rated floor/ceiling systems, timber blocks cannot be used to maintain fire-resistance as they interfere with the sound performance of the floor. The only solution available is to have continuous ceiling linings (Figure 42).

This detail is also applicable for Resistant to the Incipient Spread of Fire ceilings, refer to Section 5.5.2

![Figure 42: Internal non-rated wall intersecting a fire-rated floor/ceiling systems.](image-url)
Roof Framing Elements Supported Off Fire-Rated Walls

Where roof framing elements abut fire-rated walls, they create openings that can be sealed by the use of solid-timber blocks. Refer to Figures 43 and 44 for fire-resistance and Figures 45 for fire-resistance of 90 mins.

Figure 43: Timber blocks used to maintain fire-resistance – FRL 60 minutes in roof void – elevation view.

Figure 44: Timber blocks used to maintain fire-resistance – FRL 60 minutes in roof void – elevation view.
Timber packers graduated towards the outlet to achieve the required slope. Any gaps between packers must be fully filled with fire resistant mineral wool.

Note: Timber blocks are to be arranged so that they are continuous. Where they are required to be joined they must be arranged so that a block occurs in front of the joint.

Note: Wall must continue to underside of non-combustible roof including box gutters.

Additional 45 mm solid-timber blocking.

Figure 45: Timber blocks used to maintain fire-resistance – FRL 60 minutes under box gutter – elevation view.

Figure 46: Timber blocks used to maintain fire-resistance – FRL 90 minutes under box gutter – elevation view.
Internal Non-Fire-Rated Floors Abutting Fire-Rated Walls

There are times when floors maybe abutting a fire-rated wall but are not fire rated, such as an internal floor to a unit, or for Type C construction, when a ‘fire-protective covering’ is used instead of a fire-rated floor. In these cases, the same principle is used, with timber blocks replacing fire-resistant linings, refer to Figures 47a, 47b and 48.

**Figure 47a: Joist parallel to wall, wall stud not continuous through junction – FRL 60 minutes – elevation view.**

**Figure 47b: Joist perpendicular to wall, wall stud not continuous through junction – FRL 60 minutes – elevation view.**
NOTE: Timber blocks are to be arranged so that they are continuous. Where they are joined they must occur so that a stud or block is directly behind the joint.

Flexible fire-grade sealant

Additional 45 mm solid-timber blocking

Figure 48: Joist parallel and perpendicular to wall, wall stud continuous through junction – FRL 60 minutes only – elevation view.
Fire Pockets in Fire-Rated Walls

Another method is to create pockets within the fire-rated wall that allow the joists to bear on the wall. This detail can be achieved by utilising similar techniques discussed previously for double joists. Solid-timber blocking, the same depth as the main joists, forms the inner of the two blocking joists. Where this blocking joist is required to be joined, it must be butted closely and the joint must be at least 100 mm from any pocket created.

Floor joists such as solid timber, I-beams or floor trusses, perpendicular to the wall, can be supported on the wall and in the pocket formed, with a minimum bearing depth of 35 mm. Additional solid-timber blocks, the same depth and thickness as the inner packing block, are to be tightly cut-in between the joist. The main floor joists are not to be nailed to blocking, and any locating nailing is to occur at the base of the joist into the lower wall plate only (Figure 49a and 49b).

Figure 49a: Pockets created in separating wall to accommodate floor joists – FRL 60 minutes only – elevation view.

Figure 49b: Pockets created in separating wall to accommodate floor joists – FRL 60 minutes only – perspective view.
Top Chord Support Detail for Floor Trusses

Floor trusses are commonly used as floor joists. This form of floor joist has the unique ability to be supported by the top chord. A similar support mechanism as the pocket described above can be used. Here only the top chord needs to be located in a fire pocket. Refer to Figures 50 and 51 for two variations on the same solution for an FRL of 60 minutes.

![Diagram of floor truss top chord support detail](image_url)

Figure 50a: Floor-truss top chord supported in pocket – FRL 60 minutes – elevation view.

![Diagram of floor truss top chord support detail](image_url)

Figure 50b: Floor-truss top chord supported in pocket – FRL 60 minutes – plan view.
Timber blocking must be arranged so that the butt joints are covered by the stud behind the steel web.

45 mm solid-timber ledgers

Additional 45 mm solid-timber blocking

Fire- and sound-rated linings

Flexible fire-grade sealant

Top chord of a truss supported in a fire pocket

Additional noggings to support linings

Fire- and sound-rated linings

Figure 51: Alternative floor-truss top chord support – FRL 60 minutes – elevation view.

5.4.4 Junction Between Dissimilar Fire-Rated Elements

There are many instances where lower-rated elements abut higher-rated elements, such as a non-loadbearing SOU bounding walls abutting loadbearing SOU bounding walls. The BCA allows different Fire Resistance Levels for these elements, and therefore, the lower-rated element may be a fire path through the higher-rated element.

The recommended way to treat this is to design both elements to the highest fire rating. This removes the need to use timber blocking. In most cases the sound performance requires more plasterboard sheets than is required for fire resistance, and making use of the lower rating may not necessarily provide project savings or the desired performance.

Where the occurrence of mismatched fire-rated elements is unavoidable, the principles of sacrificial timber blocking discussed in Section 5.4.1 can be used. In this case, it is recommended to treat the lower fire-rated element as non-rated, and utilise timber blocks or timber blocks and angles as shown in this Guide.

5.4.5 Junction Between Elements with the Same Fire Ratings

When elements have the same fire-resistance, there is little required except to ensure that the fire-grade linings are supported and the board edges interweave with each other. Details for this are dependent on the lining material used, and reference to lining manufacturers is recommended for any additional requirements they may have. Typical junctions are shown in Figure 52.
Structural blocking as required
Timber joist
Steel furring channel set on noise-isolating mounts
Additional noggings to support wall linings
Additional 45 mm solid-timber blocking
Fire- and sound-rated linings
Flexible fire-grade sealant

Figure 52a: Typical junction of elements with the same FRL – fire-rated floors abutting fire-rated walls – elevation view.

Timber studs to support wall linings
Fire resistant mineral wool with vertical DPC
Where mineral wool is against external wall elements an impervious membrane is to be placed between the external wall and the mineral wool
Flexible fire-grade sealant
Fire- and sound-rated linings

Figure 52b: Typical junction of elements with the same FRL – fire-rated bounding wall abutting fire-rated external wall – plan view.
5.5 Treatment of Roof/Ceiling and Eaves Voids

5.5.1 Roof and Ceiling Voids

In Class 2 and 3 buildings there is the opportunity of fire and sound jumping from one SOU to another through the roof void. Timber-framed construction needs to prevent this happening. Three options exist, including:

- Continuation of the fire/sound wall through the roof void to the roof covering (Figure 53)
- Continuation of the fire/sound wall through the roof to a parapet wall (Figure 54)
- Stopping the flame passage at ceiling level using a Resistant to Incipient Spread of Fire ceiling (Figure 55).
5.5.2 Resistant to Incipient Spread of Fire Ceiling

This special ceiling is used directly below the roof framing instead of using bounding walls travelling to the underside of the roof. This ceiling is useful with complex roof framing elements, as the BCA does not allow any timber element to cross the bounding wall, except for minimum nominal size 75 x 50 mm roof battens.

The ceiling is required to be continuous, and walls below this ceiling must affix to it. Timber block substitution is not allowed in this case (Figure 55).
5.5.3 Eaves Voids

In addition to the mandatory requirements, there is a non-mandatory but logical need to address the cavity created by a boxed eave (or similar) that creates the means for a fire to by-pass a fire-resisting wall bounding an SOU.

This situation often occurs when an external wall is not rated, nor has a rating less than the bounding walls of the SOU. In this case it is recommended that the eaves be blocked off to limit fire spread along this path. A construction detail to address this problem is shown in Figure 56. It is same approach to the requirement for Class 1 buildings for separating walls.

![Figure 56a: Non-combustible linings blocking off eaves void – front elevation view.](image1)

![Figure 56b: Non-combustible linings blocking off eaves void – side elevation view.](image2)

As they lack mandatory requirements, eaves require common sense handling.
5.6 Shafts and Service Penetrations

5.6.1 Fire-Rated Shafts

Shafts are generally required to have a sound rating. Where they are also required to have a Fire Resistance Level, it is best to treat the shaft like an independent compartment, (Figure 57). Care is required to ensure that the sound rating is achieved, as many wall systems are not adequate on their own.

Many wall systems can't handle shafts unaided.
Where timber framing is used to support the shaft linings it must be sheeted with fire/sound-grade linings on both sides of the shaft, including the part of the shaft that is the bounding wall of the SOU. An alternative to using timber framing is to use laminated plasterboard or a shaft wall system. These systems are proprietary developed by lining manufacturers, and reference to their details is required. Refer to Figure 58 for an illustration of a typical system.

**Figure 58: Laminated fire-rated plasterboard used to create shafts.**

Another approach for Class B and C buildings is to seal the penetration at the point where it penetrates the floor or wall element with a fire collar but in many cases the service will still require a sound rating, refer to Section 5.6.2 for further details.
5.6.2 Plumbing, Electrical and Ventilation Services Penetrating a Fire-Rated Wall

Where services penetrate a fire-resistant element, the BCA requires gaps with the surrounding construction be sealed, and for some elements, that the element seals off during a fire event.

There are two approaches to satisfy the BCA. The first is to follow the requirements in Specification C3.15 in the BCA if allowed. This method details a number of elements such as pipes, and cables and gives solutions for sealing these penetrations, (Figures 59 and 60).

The other method is to use a manufacturer’s tested system. This involves selecting a system that meets the fire-resistance as well as the acoustic level required. As these systems are proprietary no further details are provided here.

In general, all penetration in fire-rated elements should be fire stopped, kept to a minimum, kept as small as possible and designed in a way that will allow thermal movement as well as shrinkage.

As ‘chinks in the armour’ of a fire-rated element, penetrations require careful and comprehensive treatment.

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Figure 59: Plumbing service penetration in fire- and sound-rated wall and floor/ceiling – elevation view.

Figure 60: Electrical service penetration in fire- and sound-rated wall and floor/ceiling.
In many cases, dealing with penetrations in fire-rated elements can be avoided by placing penetrations in external non-rated systems, or by building false walls or boxes/bulkheads, creating pockets in the fire-rated element (Figure 61 and 62).

Figure 61: False wall for services (bathroom detail) – elevation view.

Figure 62: Framing details for recessed light in fire-rated floor/ceiling.
5.7 Vertical Separation in External Walls to Protect Openings from Fire

When using timber-framed construction to create vertical separation on external walls, it is important to have a clear understanding of the BCA requirements. For instance, there is a requirement for non-combustibility in Clause C2.6 of the BCA but this is exempted by a concession in Specification C1.1 Clause 3.10 which deletes the non-combustibility requirement.

Therefore situations such as the protection of balcony doors can be achieved by fire rating the underside of the balcony floor. Care is required to ensure that the method of fire rating is not affected by moisture or the outdoor environment. In many cases a waterproof deck structure is required including a covering over the fire rating for its weather protection (Figure 63).

![Diagram of Vertical Separation in External Walls]

Figure 63: Protection of openings in external walls – elevation view.
5.8 Required Exits Stairways and Ramps

Section 4.4.5 of this guide discusses where the BCA has construction controls on exits that are stairways or ramps. These stairways or ramps are termed Fire Isolated or non-fire isolated and each have particular construction requirements. The construction requirements are discussed in more details in the following sections.

5.8.1 Non-Fire-Isolated Stairway and Ramps

Where timber is used for the construction of a Non-Fire-Isolated Stairway and ramps it must have;

- a finished thickness of not less than 44 mm;
- an average density of 800 kg/m³ at 12 % MC; and
- if made from laminated timber the adhesives must be resorcinol formaldehyde or resorcinol phenol formaldehyde.

Thinner timber, lower density or laminated products using different glues may be used via the Alternative Solution path. Some successful Alternative Solution applications in the past have used fire regrade linings, as required for the floor systems, under the stairs as an offset for the less fire-resistant Deemed to Satisfy construction solution (Figure 64).

5.8.2 Fire Isolated Stairs  BCA D2.2

Fire Isolated stairway or ramp including any landings are required by the BCA to be within a fire-resisting shaft and be constructed from non-combustible materials. In addition the structure needs to be designed so that if there is local failure it will not cause structural damage to, or impair the fire-resistance of, the shaft. For this situation masonry construction to the shaft is often used with a concrete or steel stair or ramp.

Again an all-timber solution is possible via the Alternative Solution compliance pathway.

Figure 64: Fire-resistant linings used as Alternative Solution for stairs.
5.9 Archways, Windows and Doors

There are many instances where a window, door or similar construction may penetrate through fire- and sound-rated walls. Examples of this include windows or doors or through external walls, entrance doors, or a door or opening in a fire-rated internal wall.

5.9.1 Fire-Rated Window and Doors in External Walls

Where window and door in external fire-rated walls are required to be fire rated, then the fire-rated window or door is required to be a tested or assessed system. The test or assessed system requires consideration of the type of wall that it is in is a part and that information should be available. In these cases, follow the manufacturer’s recommendation.

5.9.2 Non-Fire-Rated Window or Door in Fire-Rated Internal and External Walls

This situation often occurs in Type B and C buildings where there is no fire-resistance requirement for the actual window and door. In these situations, it is recommended that the wall linings used to protect the fire-rated wall be used to enclose the opening (Figure 65).

*Figure 65: Door openings in fire-rated walls.*
5.10 Smoke-Proof Walls

The BCA requires that Class 2 and 3 buildings with public corridors greater in length than 40 m must be divided into intervals not greater in length than 40 m with smoke-proof walls. Smoke-proof walls are required by the BCA to meet the same requirements as smoke-proof walls in Class 9a buildings (Specification C2.5 Clause 2). This requirement necessitates that smoke-proof walls be constructed from non-combustible material. As the smoke-proof wall is only required in long corridors, the wall is very short and most likely incorporates a door. For these situations, the easiest option is a proprietary system from a lining manufacturer, such as laminated plasterboard (Figure 66) or shaft wall (Figure 67). These systems need to be self-supporting, not relying on the combustible construction for support.

![Figure 66: Laminated plasterboard smoke-proof wall – elevation view.](image)

![Figure 67: Shaft liner smoke-proof wall – elevation view.](image)
5.11 Cavity Barriers

Cavity barriers are obstructions placed in concealed air spaces in fire-rated systems, that in the event of a fire, limit the spread of smoke and hot gases to other parts of the building, and reduce airborne flanking noise. They are not mandatory under the BCA, but are recommended practice.

Cavity barriers can be made out of many building products used in fire- and sound-rated timber-framed construction, and in many cases are extensions of materials already being used. Solid timber, plywood, particleboard, plasterboard, mineral wools or metal flashing can be used. The cavity barrier must extend continuously along the voids.

5.11.1 Cavity Barrier Location

Generally, cavity barriers should be placed at the corners of each compartment, i.e. at the intersection of floors and bounding walls, and bounding walls to bounding walls (refer to figure 18). The following are typical locations where cavity barriers should be installed:

- Junction between fire-rated floor and fire-rated internal bounding wall (Figure 69).
- Junction between fire-rated floor and fire-rated external walls. Note there are two option, one using mineral wool and the other a metal flashing (Figure 70).
- Junction between internal fire-rated bounding wall and external wall (Figure 71).

Figure 69: Cavity barrier at the junction of fire-rated floor and fire-rated wall – elevation view.
Where mineral wool is against external wall elements an impervious membrane is to be placed between the external wall and the mineral wool.

**Fire-rated floor/ceiling system**

**Cavity barrier**

*Figure 70: Junction between fire-rated floor and fire-rated external walls – elevation view.*

**Timber studs to support wall linings**

**Solid-timber blocking with vertical DPC**

**Fire- and sound-rated linings**

*Figure 71a: Cavity barrier (using timber blocking) at junction of fire-rated bounding wall and external wall – plan view.*

**Fire resistant mineral wool with vertical DPC**

*Figure 71b: Cavity barrier (using mineral wool) at junction of fire-rated bounding wall and external wall – plan view.*
Step 6 – Further Design Assistance (Appendices)

The previous Steps in the Guide require consideration of additional information on topics closely linked to the design of fire and sound construction. The following appendices cover structural design considerations, Deemed to Satisfy fire requirements not covered by this Guide, other design references and a Glossary.

Appendix A – Resolving Structural Design Considerations

The following issues should be taken into account in the structural design of Class 2 and 3 buildings:

- Lighter mass than masonry construction – greater attention needs to be given to resistance against overturning.
- Greater effect from wind loads than expected from timber-framed detached houses. This is due to a greater height-to-width ratio, resulting in a need for attention to resistance to overturning.
- Greater imposed loads than timber-framed detached houses because of the extra loads associated with the fire-rated wall and floor elements.
- Need to accommodate larger number of people than detached housing, resulting in larger applied loads.
- Must be constructed using specific methods for attachment of linings to achieve fire ratings.
- Greater potential for shrinkage in taller timber buildings. Shrinkage can be minimised by:
  - using seasoned timber or engineered timber;
  - constructing bearers and joists in the same plane;
  - detailing to avoid differential shrinkage between dissimilar materials, e.g. steel to timber; timber to masonry; and
  - allowing for shrinkage with respect to plumbing.

It is recommended that a professional structural engineer be employed to address the above issues and structural performance in general. The following standards and Guidelines should be called upon to assist:

- AS1170.0 – Structural design actions – General Principles.
- AS1170.1 – Structural design actions – permanent, imposed and other actions provides the basis for determination of appropriate dead, live design loads and loads combinations
- AS 1170.2 – Structural design actions – wind actions – which provides the basis for wind loads.
- AS 1170.4 – Structural design actions – Earthquake actions in Australia – which provides guidance and design procedures for earthquake forces.
- AS1720.1 – Timber structures – design methods.
- Though written for Class 1 buildings, AS 1684 – Residential timber-framed construction – can be used as a general guide for construction practices and some design of members in buildings up to two storeys, provided the appropriate adjustments are made to the relevant criteria including: permanent, imposed and wind loads. This includes allowable notching into framing members. More specific engineering design of members is required for three and four storey buildings.

In addition to the above:
• Select details that minimise the effects of shrinkage (especially since differential shrinkage may have an adverse impact on the function of fire-rated wall and floor elements).

• Check that double stud walls bounding Sole Occupancy Units are capable of supporting multi-storey load paths from above. Enlist internal walls if required.

• Check that any elements supporting loads (including bracing elements) are treated as fire-resistant construction and designed accordingly. This usually includes all external walls of the building.

• Where required, solid timber without protective fire-grade linings can be designed to perform as a fire-resistant element by allowing for an extra charring layer. A formula is required to assist in determining the correct size and help is provided by a separate timber industry document (refer reference list).

Appendix B – Deemed to Satisfy Fire Requirements Not Covered by this Guide

This publication tries to assist users wanting to use timber-framed construction under the BCA’s Deemed to Satisfy fire-resistance provisions. Even so, many of these provisions extend beyond the scope of this publication. In order to help users obtain a more holistic understanding of BCA requirements, checklists are provided in Tables B1, B2 and B3.

These lists cover the main issues raised in Parts C1, C2 and C3 of the BCA (being the three key parts contributing to the Deemed to Satisfy Provisions). The checklists aim to inform readers of what is and is not covered in this Guide. By knowing this, users can confidently speak with construction certifiers, regulatory bodies, designers, head contractors and subcontractors about the role of timber-framed construction in complying with the BCA’s Deemed to Satisfy Provisions.

Table B1: Checklist for BCA Part C1: Fire-Resistance and Stability.

<table>
<thead>
<tr>
<th>BCA Clause</th>
<th>Issue</th>
<th>Is assistance on this issue provided in this publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1.0</td>
<td>Deemed to Satisfy Provisions</td>
<td>Yes</td>
</tr>
<tr>
<td>C1.1</td>
<td>Type of Construction</td>
<td>Yes – refer Section 4.2</td>
</tr>
<tr>
<td>C1.2</td>
<td>Calculating the 'rise in storeys'</td>
<td>No</td>
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<tr>
<td>C1.3</td>
<td>Buildings of multiple classification</td>
<td>No</td>
</tr>
<tr>
<td>C1.4</td>
<td>Mixed types of construction</td>
<td>No</td>
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<tr>
<td>C1.5</td>
<td>Two storey Class 2 and 3 buildings</td>
<td>Yes – refer Section 4.2</td>
</tr>
<tr>
<td>C1.6</td>
<td>Class 4 parts of buildings</td>
<td>No</td>
</tr>
<tr>
<td>C1.7</td>
<td>Open spectator stands and indoor sports stadiums</td>
<td>No</td>
</tr>
<tr>
<td>C1.8</td>
<td>Lightweight construction</td>
<td>Yes – but only for the timber parts of lightweight construction. Requirements for fire-grade linings and other components are the responsibility of others, refer to Section 4.4.7</td>
</tr>
<tr>
<td>C1.09</td>
<td>No requirements in the BCA</td>
<td>NA</td>
</tr>
<tr>
<td>C1.10</td>
<td>Fire hazard properties</td>
<td>No – advice on suitable species and application can be found on <a href="http://www.timber.net.au">www.timber.net.au</a></td>
</tr>
<tr>
<td>C1.11</td>
<td>Performance of external walls in the fire</td>
<td>No – This item only applies to concrete external walls</td>
</tr>
<tr>
<td>C1.12</td>
<td>Non-combustible materials</td>
<td>No – Not necessary but note that plasterboard and fibre-cement sheets are deemed non-combustible</td>
</tr>
<tr>
<td>BCA Clause</td>
<td>Issue</td>
<td>Is assistance on this issue provided in this publication</td>
</tr>
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<td>------------</td>
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<td>C2.0</td>
<td>Deemed to Satisfy Provisions</td>
<td>Yes</td>
</tr>
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<td>C2.1</td>
<td>Application of Part</td>
<td>Yes – general information on relevant clauses required to be considered for a design</td>
</tr>
<tr>
<td>C2.2</td>
<td>General floor area and volume limitations</td>
<td>No – not relevant</td>
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<tr>
<td>C2.3</td>
<td>Large isolated buildings</td>
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<tr>
<td>C2.4</td>
<td>Requirements for open spaces and vehicular access</td>
<td>No – not relevant</td>
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<tr>
<td>C2.5</td>
<td>Class 9a and 9c buildings</td>
<td>No – not relevant</td>
</tr>
<tr>
<td>C2.6</td>
<td>Vertical separation of openings in external walls</td>
<td>Yes – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
<tr>
<td>C2.7</td>
<td>Separation by firewalls</td>
<td>No – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
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</table>
| C2.8       | Separation of classifications in the same storey                     | No – but refer publication BCA Compliant Sound-
and fire-rated Timber-Framed Construction – Design and Construction Guide for Class 5, 6, 9a and 9b Buildings – office, shops and public buildings |
| C2.9       | Separation of classifications in different stories                   | No – but refer publication BCA Compliant Sound-
and fire-rated Timber-Framed Construction – Design and Construction Guide for Class 5, 6, 9a and 9b Buildings – office, shops and public buildings |
| C2.10      | Separation of lift shafts                                             | No – designer to interpret relevance then if required, select an appropriately rated timber detail |
| C2.11      | Stairways and lifts in one shaft                                     | No – not relevant                                        |
| C2.12      | Separation of equipment                                               | No – designer to interpret relevance, then if required, select an appropriately rated timber detail |
| C2.13      | Electricity supply system                                             | No – designer to interpret relevance, then if required, select an appropriately rated timber detail |
| C2.14      | Public corridors in Class 2 and 3 of buildings                        | Yes – go to Section 5.10                                 |

**Table B2: Checklist for BCA Part C2: Compartmentalisation and Separation.**
Table B3: Checklist for BCA Part C3: Protection of Openings.

<table>
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<th>BCA Clause</th>
<th>Issue</th>
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<td>C3.0</td>
<td>Deemed to Satisfy Provisions</td>
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<tr>
<td>C3.1</td>
<td>Application of Part</td>
<td>No – general information on relevant clauses required to be considered for a design</td>
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<td>C3.2</td>
<td>Protection of openings in external wall</td>
<td>No – but relevant to a building design</td>
</tr>
<tr>
<td>C3.3</td>
<td>Separation of external walls and associated openings in different fire compartments</td>
<td>No – but maybe relevant to a building design</td>
</tr>
<tr>
<td>C3.4</td>
<td>Acceptable methods of protection</td>
<td>No – but relevant to a building design</td>
</tr>
<tr>
<td>C3.5</td>
<td>Doorways in fire walls</td>
<td>No – but maybe relevant to a building design</td>
</tr>
<tr>
<td>C3.6</td>
<td>Sliding fire door</td>
<td>No – but maybe relevant to a building design</td>
</tr>
<tr>
<td>C3.7</td>
<td>Protection of doorways in horizontal exits</td>
<td>No – but maybe relevant to a building design</td>
</tr>
<tr>
<td>C3.8</td>
<td>Openings in fire-isolated exits</td>
<td>No – but maybe relevant to a building design</td>
</tr>
<tr>
<td>C3.9</td>
<td>Service penetrations in fire-isolated exits</td>
<td>No</td>
</tr>
<tr>
<td>C3.10</td>
<td>Openings in fire-isolated lift shafts</td>
<td>No – but maybe relevant to a Class 3 buildings</td>
</tr>
<tr>
<td>C3.11</td>
<td>Bounding construction: Class 2, 3 and 4 buildings</td>
<td>Yes</td>
</tr>
<tr>
<td>C3.12</td>
<td>Openings in floors and ceilings for services</td>
<td>Yes – refer to Sections 4.4.6 and 5.6</td>
</tr>
<tr>
<td>C3.13</td>
<td>Opening in shafts</td>
<td>Yes – refer to Section 5.6</td>
</tr>
<tr>
<td>C3.14</td>
<td>No requirements in BCA</td>
<td>No</td>
</tr>
<tr>
<td>C3.15</td>
<td>Openings for services installation</td>
<td>No – but relevant to a building design</td>
</tr>
<tr>
<td>C3.16</td>
<td>Construction joints</td>
<td>Yes – refer to Sections 5.4</td>
</tr>
<tr>
<td>C3.17</td>
<td>Columns protected with lightweight construction to achieve an FRL</td>
<td>No – but maybe relevant to a building design</td>
</tr>
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</table>
Appendix C – Design References

Design References

**Australian Building Codes Board**
- National Construction Code Series Volume 1, Building Code of Australia (BCA) Class 2 to Class 9 buildings

**Australian Standards**
- AS1530.4 – Methods for fire tests on building materials, components and structures – Fire-resistance tests on elements of construction.
- AS/NZS 1267.1 Acoustics – Rating of sound insulation in buildings and building elements.
- AS/NZS 2908.2 – Cellulose cement products – Flat sheets.
- AS4072.1 – Components for the protection of openings in fire-resistant separating elements – Service penetration and control joints.

**WoodSolutions.**
The following publications are available as free downloads at woodsolutions.com.au:
- #01 Timber-Framed Construction for Townhouse Buildings Class 1 – Design and construction guide for BCA compliant sound – and fire-rated construction.
- #03 Timber-Framed Construction for Commercial Buildings Class 5, 6, 9a and 9b – Design and construction guide for BCA compliant fire-rated construction.
- #06 Timber-framed Construction Sacrificial Timber Construction Joint
- #11 Timber Framed Systems for External Noise
- #17 Alternative Solution Fire Compliance: Timber Structures
- #18 Alternative Solution Fire Compliance: Facades
- #19 Alternative Solution Fire Compliance: Linings

**Test and Assessment Reports**

**Bodycote Warringtonfire (Aus)**

Free resources are available at woodsolutions.com.au
Exova Warringtonfire Australia

- 22221A-00 Assessment Report: The likely fire resistance performance of various MRTFC roof and wall junctions in fire resistant wall construction if tested in accordance with AS1530.4 – 2005, July 2010

Appendix D – Glossary

BCA
Building Code of Australia – Volume 1 – Class 2 to 9 Buildings.

Cavity barrier
A non-mandatory obstruction installed in concealed cavities within fire-rated wall or floor/ceiling systems.

Discontinuous construction
A wall system having a minimum of 20 mm cavity between two separate wall frames (leaves) with no mechanical linkage between the frames except at the periphery i.e. top and bottom plates.

Construction joint
Discontinuities of building elements and gaps in fire-rated construction required by the BCA to maintain fire resistance. Refer to Deemed-to-Satisfy Provision C3.16, Volume 1, BCA.

Exit
Includes any of the following if they provide egress to a road or open space:
- an internal or external stairway
- a ramp complying with Section D of the BCA
- a doorway opening to a road or open space.

Fire-grade lining
Either fire-grade plasterboard, fibre-cement or a combination of both, used to provide the required Fire Resistance Level (FRL) for walls or floor/ceiling systems. Individual linings manufacturers should be contacted to determine the extent to which a given lining material provides fire-resisting properties.

Fire-isolated stair or ramp
A Stair or ramp construction of non-combustible materials and within a fire-resisting shaft or enclosure.

Fire-isolated passageway
A corridor or hallway of fire-resisting construction which provides egress to a fire-isolated stairway or ramp.

Fire-protective covering
- 3 mm fire-grade plasterboard; or
- 2 mm cellulose fibre-reinforced cement sheeting complying with AS 2908.2; or
- 2 mm fibrous plaster reinforced with 13 mm x 13 mm x 0.7 mm galvanized steel wire mesh located not more than 6 mm from the exposed face; or
- Other material not less fire-protective than 13 mm fire-grade plasterboard.

Note: Fire-protective covering must be fixed in accordance with normal trade practice (e.g. joints sealed).

Fire Resistance Level (FRL)
The period of time in minutes, determine in accordance with Specification A2.3 (of the BCA) for the following:
- Structural adequacy
- Integrity
- Insulation.
Fire-resisting mineral wool
Compressible, non-combustible, fire-resisting material used to fill cavities and maintain fire resistance or restrict the passage of smoke and gases at gaps between other fire-resisting materials.

NOTE: The mineral wool to be used in all applications in this manual, must be fire-resisting and therefore must have a fusion temperature in excess of 1160º C. ‘Rockwool’ type products generally meet these requirements, while ‘glasswool’ products do not.

Fire-resisting (Fire-rated)
As applied to a building element means, having the FRL required by the BCA for that element.

Fire-resisting construction
Construction which satisfies Volume 2 of the BCA.

Fire-resisting junction
The intersection between a fire-rated wall or floor/ceiling system and or another rated or non-rated system, which maintain the fire resistance at the intersection.

Fire-resisting sealant
Fire-grade material used to fill gaps at joints and intersections in fire-grade linings to maintain Fire Resistance Levels.

Note: The material should also be flexible to allow for movement and where required waterproof as well.

Fire-source feature
Either:
- the far boundary of a road adjoining the allotment; or
- a side or rear boundary of the allotment; or
- an external wall or another building on the allotment which is not of Class 10.

Habitable room
A room for normal domestic activities and includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room and sunroom, but excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.

Internal walls
Walls within, between or bounding separating walls but excluding walls that make up the exterior fabric of the building.

Note: Fire walls or common walls between separate buildings or classifications are NOT internal walls.

Lightweight construction
Construction which incorporates or comprises sheet or board material, plaster, render, sprayed application, or other material similarly susceptible to damage by impact, pressure or abrasion.

Non-combustible
Applied to a material not deemed combustible under AS 1530.1 – Combustibility Tests for Materials; and applied to construction or part of a building – constructed wholly of materials that are not deemed combustible.

Performance Requirements
The objectives, functional statements and requirements in the Building Code of Australia that describe the level of performance expected from the building, building element or material.

\( R_w \)
Refer to Weighted sound reduction index.

Unit
Sole-Occupancy unit.

Weighted sound reduction index \( (R_w) \)
The rating of sound insulation in a building or building element as described in AS/NZS 1267.11999.
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