Timber-framed Construction for Commercial Buildings Class 5, 6, 9a & 9b

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

Technical Design Guide issued by Forest and Wood Products Australia
WoodSolutions Technical Design Guides

A growing suite of information, technical and training resources, the Design Guides have been created to support the use of wood in the design and construction of the built environment.

Each title has been written by experts in the field and is the accumulated result of years of experience in working with wood and wood products.

Some of the popular topics covered by the Technical Design Guides include:

- Timber-framed construction
- Building with timber in bushfire-prone areas
- Designing for durability
- Timber finishes
- Stairs, balustrades and handrails
- Timber flooring and decking
- Timber windows and doors
- Fire compliance
- Acoustics
- Thermal performance

More WoodSolutions Resources

The WoodSolutions website provides a comprehensive range of resources for architects, building designers, engineers and other design and construction professionals.

To discover more, please visit
www.woodsolutions.com.au
The website for wood.

WoodSolutions is an industry initiative designed to provide independent, non-proprietary information about timber and wood products to professionals and companies involved in building design and construction.

WoodSolutions is resourced by Forest and Wood Products Australia (FWPA). It is a collaborative effort between FWPA members and levy payers, supported by industry peak bodies and technical associations.

This work is supported by funding provided to FWPA by the Commonwealth Government.


Researcher:
Timber Development Association (NSW)
Suite 604-486 Pacific Highway
St Leonards NSW 2065

Printed: May 2010
Revised: May 2012, August 2012, September 2015

© 2015 Forest and Wood Products Australia Limited.
All rights reserved.

These materials are published under the brand WoodSolutions by FWPA.

IMPORTANT NOTICE

Whilst all care has been taken to ensure the accuracy of the information contained in this publication, Forest and Wood Products Australia Limited and WoodSolutions Australia and all persons associated with them (FWPA) as well as any other contributors make no representations or give any warranty regarding the use, suitability, validity, accuracy, completeness, currency or reliability of the information, including any opinion or advice, contained in this publication. To the maximum extent permitted by law, FWPA disclaims all warranties of any kind, whether express or implied, including but not limited to any warranty that the information is up-to-date, complete, true, legally compliant, accurate, non-misleading or suitable.

To the maximum extent permitted by law, FWPA excludes all liability in contract, tort (including negligence), or otherwise for any injury, loss or damage whatsoever (whether direct, indirect, special or consequential) arising out of or in connection with use or reliance on this publication (and any information, opinions or advice therein) and whether caused by any errors, defects, omissions or misrepresentations in this publication. Individual requirements may vary from those discussed in this publication and you are advised to check with State authorities to ensure building compliance as well as make your own professional assessment of the relevant applicable laws and Standards.

The work is copyright and protected under the terms of the Copyright Act 1968 (Cwlth). All material may be reproduced in whole or in part, provided that it is not sold or used for commercial benefit and its source (Forest & Wood Products Australia Limited) is acknowledged and the above disclaimer is included. Reproduction or copying for other purposes, which is strictly reserved only for the owner or licensee of copyright under the Copyright Act, is prohibited without the prior written consent of FWPA.

WoodSolutions Australia is a registered business division of Forest and Wood Products Australia Limited.
# Table of Contents

**Introduction** 4

**Step 1 – High-Level BCA Design Issues** 6

1.1 Determining the Class of Building 6
1.2 BCA Compliance – Deemed to Satisfy or Alternative Solution 6
1.3 Determining the Spatial Setout of the Building 7

**Step 2 – Define BCA Fire-Design Requirements** 8

2.1 Utilising the Deemed to Satisfy Provisions for Fire Design 8
2.2 Determining the Type of Construction Required 8
2.3 Adjusting for Multiple Building Classifications 9
2.4 Support of Another Part 10
2.5 Adjusting for Mixed Types of Construction 10
2.6 Determining Fire Resistance Levels for Building Elements 12

**Step 3 – Selecting Fire-Rated Timber Construction Systems** 18

3.1 Principles for Achieving Fire Resistance Levels in Timber-Framed Construction 18
3.2 Fire-Rated Wall Construction Systems 20
3.3 Construction Joints 25
3.4 Sacrificial Charring Timber 32
3.5 Ceilings Resistant to Incipient Spread of Fire 34
3.6 Plumbing, Electrical Service and Mechanical Ventilation Penetrations in Fire-Resistant Wall 34
3.7 Non-Fire-Isolated Stairways 37
3.8 Smoke-Proof Walls For Class 9a 37
3.9 Strategies for Upgrading Sound Performance in Floor Construction 39

**Step 4 – Further Design Assistance (Appendices)** 43

Appendix A – Resolving Structural Design Considerations 44
Appendix B – Deemed to Satisfy Fire Requirements Not Covered By This Guide 45
Appendix C – References 48
Appendix D – Glossary 49
Introduction

This Guide is for designers, specifiers, builders, code officials and certifying authorities who want to use or interpret fire-resisting timber-framed construction that complies with the Building Code of Australia (BCA). The Guide 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 detailed below.

Scope

For timber-framed construction, this Guide demonstrates achievement of targeted fire Performance Requirements in the Building Code of Australia for Class 5, 6, 9a and 9b buildings. It focuses specifically on fire-resisting construction of wall, floor and ceiling elements. In this context, the Guide provides certified construction details that utilise the BCA’s Deemed to Satisfy Provisions. This Guide does not deal with other aspects of BCA fire safety performance, refer to Appendix B of this document for further details.

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 has been prepared from a number of sources, the main being a guide called – Timber-Framed Construction Sacrificial Timber Construction Joints – Design guide for BCA compliant fire-rated construction. This guide also documents the fire tests and assessments used to support the details used in this manual.

Other information sources that support this guide are referenced in Appendix C.
Design process for 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 spatial setout issues in the building

Step 2 – Define BCA Fire-Design Requirements
- Utilise the Deemed to Satisfy Provisions for fire design
  - Determine the Type of Construction required for fire-resistance
    - Adjust and re-determine for multiple building classifications
      - Adjust and re-determine mixed construction types
        - Determine the Fire Resistance Levels of elements, e.g. walls, floors

Step 3 – Select Fire-Rated Timber Construction
- Concepts in fire-rated timber construction
  - Select a fire-rated timber-framed system
    - Detail the selected system, e.g. joints, penetrations

Step 4 – Further Design Assistance (Appendices)
- Structural considerations, other BCA requirements, references, glossary

Taking a step-by-step approach reduces complex designs to manageable elements.
Step 1 – High-Level BCA Design Issues

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

1.1 Determining the Class of Building

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

• **Class 5 buildings** – an office building used for professional or commercial purposes excluding buildings of Class 6, 7, 8 or 9.

• **Class 6 buildings** – a shop or other building for the sale of goods by retail or the supply of services direct to the public, including:
  – an eating room, cafe, restaurant, milk or soft-drink bar;
  – a dining room, bar, shop or kiosk part of a hotel or motel;
  – a hairdresser’s or barber’s shop, public laundry, or undertaker’s establishment; or
  – a market or sale room, showroom, or service station.

• **Class 9 buildings (a & b only)** – a building of a public nature including:
  – a health-care building including those parts of the building set aside as a laboratory;
  – an assembly building including a trade workshop, laboratory or the like in a primary or secondary school, but excluding any other parts of the building that are of another Class. (Note: Class 9c are dealt with in the publication Timber-Framed Construction for Multi-Residential Buildings Class 2, 3 and 9c – Design and construction guide for BCA compliant sound- and fire-rated construction – Book #02.

These classes are dealt with in Volume 1 of the BCA and so all future references are made with relevance to this volume. It is important that users choose which Class is applicable to their building project because it effects the Type of Construction required to resist fire. This in turn influences the timber-framed construction system that will be needed for the project.

1.2 BCA Compliance – Deemed to Satisfy or Alternative Solution

BCA Performance Requirements can be achieved for the above building classes in two different ways:

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

• Alternative Solution – this means a solution not dealt with under the 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-resisting construction that 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.
1.3 Determining the Spatial Setout of the Building

Spatial issues influence the fire separation and compartmentalisation requirements of Class 5, 6, 9a and 9b buildings. For instance, the size or volume of a fire compartment must not exceed the stated maximum floor area provided in the BCA (C2.2). Related conditions are also provided in Clauses C2.3 and C2.4 of the BCA. Determining spatial requirements is important because it then influences the type of fire-resisting construction that must be used in the building (as dealt with in more detail under Step 2 of this Guide).

Another issue is the need to define individual Sole Occupancy Units (SOUs) within Class 5, 6, 9a and 9b buildings. SOUs help separate a given building into manageable units for dealing with fire performance. The concept is influenced by the way ownership is divided up within the building as follows:

- An SOU is a room or other part of a building for occupation by an owner, lessee, tenant or other occupier, to the exclusion of others;
- SOUs must be designed to restrict fire entering from adjoining SOUs and certain other parts of the building.

As a result of the above, not all Class 5, 6, 9a and 9b buildings need to be considered in terms of SOUs, however where relevant, the wall, floor and ceiling elements that bound SOUs are central in achieving BCA fire Performance Requirements. Here, specific requirements vary depending on whether the SOUs are:

- side by side;
- stacked on top of each other (as well as side by side); or
- adjoining a different type of room or space (such as a public corridor).

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

Refer to:
BCA C2.2 to C2.4.

Figure 2: Example of Sole Occupancy Units (SOU).
Step 2 – Define BCA Fire-Design Requirements

Designing fire-resistant construction involves a process of understanding how the BCA’s performance requirements translate into more objective and measurable Deemed to Satisfy Provisions and then selecting timber-framed construction systems that suit these requirements. Details about Deemed to Satisfy design requirements are discussed in this Step of the Guide.

2.1 Utilising the Deemed to Satisfy Provisions for Fire Design

Part C of the Building Code of Australia Performance Requirements are concerned with safeguarding people when a fire occurs in a building. Specific attention is given to the evacuation of 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, floor and ceiling elements) that are dealt with in this Guide, as these elements can be made using 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.

2.2 Determining the Type of Construction Required

The main issue of interest to 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 ‘rise in storeys’ of the building. This is a BCA term relevant for fire-resistance design, refer to BCA C1.2.
- Determine if the construction is Type A, B or C construction, refer to BCA C1.1. This is done in conjunction with compartmentalisation limits for floor area/building volume, refer to BCA 2.2. The three Types of Construction are:
  - 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.
- Take into account any adjustments arising due to multiple building classifications (BCA C1.3) and ‘mixed types of construction’ (BCA C1.4) and then finalise the Type of Construction as required.

A chart for assisting the selection of the appropriate type of construction is shown in Table 1. It also allows users to determine if an all timber-framed building solution is possible under the Deemed to Satisfy Provisions (darker shaded region), or if an Alternative Solution (light shaded region) will be necessary. In all Types of Construction some timber framing is allowed. This explained further in the following section.
### Table 1: Determining the type of construction, ‘Rise in Storey’ and Spatial Limits under Deemed to Satisfy Provisions.

<table>
<thead>
<tr>
<th>Rise in Storey</th>
<th>Class 5</th>
<th>Class 6</th>
<th>Class 9</th>
<th>9b School, Theatres, Sports Hall, etc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office</td>
<td>Shop, Restaurant</td>
<td>9a Healthcare Building</td>
<td></td>
</tr>
<tr>
<td>4 or More</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>C</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Dark-shaded areas represent where timber-framed construction is permitted as a Deemed to Satisfy building solution.
2. Light-shaded areas require an Alternative Solution (refer to Appendix D, Reference List for an appropriate Guide on this topic).
3. Conditions affecting areas and volumes should be determined by referring to BCA clauses C2.2 to C2.4.

### 2.3 Adjusting for Multiple Building Classifications

Where multiple building classifications occur within the same building (BCA C1.3), the Type of Construction for the entire building is determined by the building classification at the topmost storey and the total ‘rise in storeys’ of that building. With regard to this, there are some instances where a Deemed to Satisfy timber-framed solution can be used, and others where it is not allowed. This is best explained by way of example.

**Example: Topmost Storey Determines Classification**

Figure 3 shows two buildings the left hand building is defined as a Class 9a building, Type C construction, with a rise of one storey; the right hand side is defined as a Class 5 (office) building, Type C construction, with a rise of two storeys. Both buildings can be built using Deemed to Satisfy timber-framed construction.

If the right hand side building has its lowest storey replaced with a Class 9a (Figure 4) the combined buildings must now comply with Clause C1.3 of the BCA. Clause C1.3 requires buildings with mixed classification to apply the top most storey’s classification (Class 5 in our example case) to all other storeys, but only for determining the construction type.
This means that the entire building for the purpose of determining the construction type is now considered to be Class 5 with a rise of two storeys, which by Table C1.1 is a Type C construction. The FRL and association construction for the 9a part of the building may in fact have different requirement to a Class 5 building. The associated Fire Resistance Level for each construction type must be applied to the respective parts.

**Figure 4: Mixed construction example – elevation view.**

To extend the example further, it is worthwhile reversing the Class 9a portion of the building from being the bottom floor to the top floor (Figure 5).

**Figure 5: Mixed construction example – elevation view.**

There is still a rise of two storeys in the building but now the top most storey is a building Classification Class 9a. This means the building would now be considered a Type B construction (refer Table 1). The Deemed to Satisfy Provisions in the BCA require such construction to have internal walls built of concrete or masonry and external walls non-combustible. This excludes the general use of timber framing and this becomes clearer when it is considered that the BCA requires a building element that supports a fire-resistant building element, or has a higher fire-resistance, or if it requires to be non-combustible, then itself has to be the higher fire-resistance or be non-combustible. Therefore, the Class 5 portion of the building is also required to have its internal walls built of concrete and its external walls to be non-combustible. In addition the higher Fire Resistance Level of the Class 9a portion is also required for the lower storey. The only allowed Deemed to Satisfy uses of timber framing are the floors, some internal walls and the roof.

### 2.4 Support of Another Part

Where a part of a building that is above another part of the building has fire-resistance greater than the lower part BCA Spec C1.1 Clause 2.2 requires the lower part to also have similar fire-resistance. This includes any requirement to be non-combustible.

### 2.5 Adjusting for Mixed Types of Construction

Some buildings may benefit from being considered as mixed types of construction, refer BCA C1.4, especially where they can be vertically separated by a ‘fire wall’. Here, the compartments are considered for the purpose of determining fire-resistance as separate buildings. This allows parts of building to have a different Type of Construction allowing timber options to be used. Potential benefits of this are demonstrated by way of an example.

**Example: Use of Fire Walls**

For the following two buildings, the left hand building is defined as a Class 6 building (restaurant), Type C construction, with a rise of two storeys; the right hand side is defined as a Class 9b (theatre) building, Type C construction, with a rise of one storey. Under the Deemed to Satisfy Provisions, both can be built separately using timber-framed construction (Figure 6).
If the two buildings are combined side by side (Figure 7) we now have one building with a rise of two storeys. As discussed under the previous Section 3.3, the upper most storey is now a Class 6. For the purpose of determining the building ‘construction type’, the Class 6 is applied across the whole building. In this example the building classification is now Type C.

A fire wall permits separate consideration of adjacent buildings.

Now if it was the other way around with the left hand building defined as a Class 9b building (theatre), and the right hand side is defined as a Class 6 (restaurant) building. Therefore as the upper most storey is now a Class 9b with a rise in storey of two, the building classification is now a Type B, which does not allow a Deemed to Satisfy timber solution for the wall frames (Figure 8).

To overcome this, BCA Clause C1.4 allows the building to be separated by a ‘fire wall’ constructed to BCA Clause C2.7. This allows the building to be considered for the purpose of fire-resistance, as two separate buildings (Figure 9).
The fire wall has to be constructed to the highest Fire Resistance Level of the two construction Types and due to the different heights of the building there are requirements as to where the fire wall is required to finish. Refer to BCA Clause C2.7. In this case the Class 6 component can be built in timber framing.

The same is not allowed for horizontal separation. In this case an Alternative Solution is recommended.

### 2.6 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 element 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/ –.

#### 2.6.1 Type A Construction

Generally, the Deemed to Satisfy timber framing permitted in a Type A building are walls that have no fire-resistance requirement, floors or a number of elements on the top most floor under a roof that has no fire-resistance requirements. The remainder require the use of an Alternative Solution to gain acceptance. Table 2 summaries the Fire Resistance Level requirements as well as indicating whether timber framing meets the BCA Deemed to Satisfy requirements, and Figure 10 is an illustration of elements that can be timber framed.

![Figure 10: Illustration of timber framing that meets the BCA Deemed to Satisfy Requirements or requires an Alternative Solution.](image-url)

Refer to: 
BCA Specification C1.1.
### Table 2: Type A Construction Deemed to Satisfy (DTS) Requirements.

<table>
<thead>
<tr>
<th>BUILDING ELEMENTS</th>
<th>FRL</th>
<th>Timber framing meets DTS requirement?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 5, 9</td>
<td>Class 6</td>
</tr>
<tr>
<td>EXTERNAL WALLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>1.5 m to less than 3 m</td>
<td>120/90/90</td>
<td>180/180/120</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>120/60/30</td>
<td>180/120/90</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>– / 120/120</td>
<td>– / 180/180</td>
</tr>
<tr>
<td>1.5 m to less than 3 m</td>
<td>– / 90/90</td>
<td>– / 180/120</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>EXTERNAL COLUMN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 3.0 m</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>COMMON WALLS</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>FIRE WALLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>FIRE WALLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounding public corridors and lobbies</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>BETWEEN SOUs</td>
<td>Loadbearing</td>
<td>120/ – / –</td>
</tr>
<tr>
<td></td>
<td>Non-loadbearing</td>
<td>– / 120/120</td>
</tr>
<tr>
<td></td>
<td>Bounding public corridors and lobbies</td>
<td>120/ – / –</td>
</tr>
<tr>
<td></td>
<td>Non-loadbearing</td>
<td>– / 120/120</td>
</tr>
<tr>
<td>Internal SOU Walls</td>
<td>Loadbearing</td>
<td>120/120/120</td>
</tr>
<tr>
<td></td>
<td>Non-loadbearing</td>
<td>180/180/180</td>
</tr>
<tr>
<td>Internal Walls, Beams, Trusses and Columns</td>
<td>Loadbearing</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>Non-loadbearing</td>
<td>Nil</td>
</tr>
<tr>
<td>FLOORS</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>ROOFS</td>
<td>120/60/30</td>
<td>180/60/30</td>
</tr>
</tbody>
</table>

Note: Figure 10 and Table 2 represent an interpreted version of information contained in BCA Specification C1.1. Direct reference to the BCA is recommended.
Floors

The BCA allows the use of timber floors in Type A construction. The only area of restriction is for floors used in lift pits, which must be non-combustible.

The BCA also has concessions for floors in Class 5 and 9 that are over areas that are not classified as a storey, not used for car parking, work area or other ancillary purpose. The concession removes the need for an Fire Resistance Level.

Wall Framing

There are no Deemed to Satisfy solutions for timber framing for external walls, common walls, loadbearing internal walls and fire wall or non-loadbearing walls required to be fire-resistant, i.e. fire-resisting stair shafts. Walls that are not required to be fire-resistant such as walls within a SOU can be timber framed.

The BCA also has a concession for internal walls (loadbearing or non-loadbearing) for the top most floor of a building, that has a ‘rise in storey’ of three or less, that is not less than 1.5 m from a window that is exposed to a fire source (boundary or another building), and does not have a roof with a Fire Resistance Level. These wall types are not required to have a fire-resistance.

Roof Elements

Timber framing can be used for roof elements as long as it has the required Fire Resistance Level. For building with non-combustible roof coverings a Fire Resistance Level is not required, as long as the building has a ‘rise in storeys’ of three or less, or, a complying sprinkler installed, or has a 60 minutes Resistant to Incipient Spread of Fire ceiling directly below the roof.

Timber Column

Where a building has a ‘rise in storey’ of three or less, and is not less than 1.5 m from a window that is exposed to a fire source (boundary or another building), and does not have a roof with a required fire-resistance, then the internal columns for the top most floor of this building are not required to have a fire-resistance, and consequently there are no limitations on the use of timber columns.

2.6.2 Type B Building Construction

Generally, the Deemed to Satisfy timber framing permitted in a Type B building are walls that have no fire-resistance requirement, floors, roofs or a number of elements on the top most floor. The remainder require the use of an Alternative Solution to gain acceptance. Table 3 summarises the FRL requirements as well as indicating whether timber framing meets the BCA Deemed to Satisfy requirements. Figure 11 is an illustration of where timber can be used.

![Figure 11: Illustration of timber framing that meets the BCA Deemed to Satisfy Requirements or requires an Alternative Solution.](image-url)
### Table 3: Type B Construction Deemed to Satisfy (DTS) Requirements.

<table>
<thead>
<tr>
<th>BUILDING ELEMENTS</th>
<th>FRL</th>
<th>Timber framing meets DTS requirement?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXTERNAL WALLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>1.5 m to less than 3 m</td>
<td>120/90/60</td>
<td>180/120/90</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>120/30/30</td>
<td>180/90/60</td>
</tr>
<tr>
<td>9.0 m to less than 18 m</td>
<td>120/0/0</td>
<td>180/60/0</td>
</tr>
<tr>
<td>18 m or more</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>– /120/120</td>
<td>– /180/180</td>
</tr>
<tr>
<td>1.5 m to less than 3 m</td>
<td>– /90/60</td>
<td>– /120/90</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>EXTERNAL COLUMN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 3.0 m</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>COMMON WALLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120/120/120</td>
<td>180/180/180</td>
<td>No</td>
</tr>
<tr>
<td><strong>FIRE WALLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>120/120/120</td>
<td>180/180/180</td>
</tr>
<tr>
<td><strong>INTERNAL WALLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire-resisting lift and stair shafts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/120/120</td>
<td>180/120/120</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>– /120/120</td>
<td>– /120/120</td>
</tr>
<tr>
<td>Bounding public corridors and lobbies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>INTERNAL SOU WALLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>BOUNDING PUBLIC CORRIDORS AND LOBBIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td>Non-loadbearing</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>INTERNAL COLUMNS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loadbearing</td>
<td>120/ – / –</td>
<td>180/ – / –</td>
</tr>
<tr>
<td><strong>FLOORS</strong> (9a and 9b only)</td>
<td>RTISF, or 30/30/30, or Fire-protective covering</td>
<td>RTISF, or 30/30/30, or Fire-protective covering</td>
</tr>
<tr>
<td>Separating units or above garages</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ROOFS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>Nil</td>
<td>Yes – refer to BCA Spec C1.1, 3.6.2.3</td>
</tr>
</tbody>
</table>

**Notes:**
1. Floors that are protected by ‘fire-protective covering’ or Resistant to Incipient Spread of Fire ceilings, do not always require their support structure to also have fire-resistance. The BCA ‘support of another part requirement is only for elements that have a Fire Resistance Level. Refer to BCA Spec C1.1 Clause 2.2.
2. The Figure 11 and Table 3 represent an interpreted version of information contained in BCA Specification C1.1. Direct reference to BCA is recommended.
3. RTISF means Resistance to Incipient Spread of Fire.
Floors

The BCA allows the use of timber floors in Type B construction. The only area where timber cannot be used is for floors used in lift pits as these floors are required to be non-combustible.

Generally, there is no fire-resistant requirements except for floors in Class 9a or 9b buildings where floors that separate a storey or are above a space for car parking, storage or other purpose. The BCA gives a range of options for their fire protection, these include a ceiling that has a 60 minutes resistant to incipient spread to fire, or Fire Resistance Level of 30/30/30 or a fire-protective covering installed on the underside of the floor.

General Wall Framing

Timber framing cannot be used in external walls, common walls, loadbearing internal walls and loadbearing fire walls or non-loadbearing internal walls required to be fire-resistant, i.e. fire-resisting stair shafts. The exception to this is for the storey directly below a roof of Class 5, 6 and 9 buildings, where internal walls, either loadbearing or non-loadbearing, are not required to be fire-resistant. These walls maybe timber framed.

Therefore, timber-framed walls can be used in non-loadbearing walls between SOU and corridors, the non-loadbearing internal walls within the SOU and the loadbearing and non-loadbearing, non-fire-resistant walls in the storey directly below the roof.

Roof Elements

There is no fire-resisting requirements for roof elements, timber framing can generally be used.

Timber Columns

For Class 5, 6 and 9 buildings columns used internally to the building can be timber. Internal timber columns in the storey directly below the roof are not required to have fire-resistance.

If the column supports another fire-rated element then the column is require to have the same Fire Resistance Level. If the column supports a Resistant to Incipient Spread of Fire ceiling, or a fire ‘protective covering’ to a floor, as these floor protection methods have no Fire Resistance Level, the column itself also has no Fire Resistance Level requirement.

2.6.3 Type C Construction

Generally, Deemed to Satisfy timber framing is permitted in all parts of a Type C building. Table 4 summarises the Fire Resistance Level requirements as well as indicating whether timber framing meets the BCA Deemed to Satisfy requirements. Figure 10 is an illustration of where timber can be used.

![Figure 12: Illustration of timber framing that meets the BCA Deemed to Satisfy Requirements or requires an Alternative Solution.](image-url)
### Table 4: Type C Construction Deemed to Satisfy (DTS) Requirements.

<table>
<thead>
<tr>
<th>BUILDING ELEMENTS</th>
<th>FRL</th>
<th>Class 5, 9</th>
<th>Class 6</th>
<th>Timber framing meets DTS requirement?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXTERNAL WALLS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>90/90/90</td>
<td>90/90/90</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1.5 m to less than 3 m</td>
<td>60/60/60</td>
<td>60/60/60</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>EXTERNAL COLUMN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 1.5 m</td>
<td>90/–/–</td>
<td>90/–/–</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>less than 3.0 m</td>
<td>60/–/–</td>
<td>60/–/–</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.0 m or more</td>
<td>Nil</td>
<td>Nil</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>COMMON WALLS &amp; FIRE WALLS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounding public corridors, public lobbies or between SOUs</td>
<td>Nil</td>
<td>Nil</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bounding a stair if require to be fire rated</td>
<td>60/60/60</td>
<td>60/60/60</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>FLOORS</strong> (9a and 9b only)</td>
<td>Separating units or above garages</td>
<td>30/30/30, or Fire-protective covering</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>ROOFS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>Nil</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Note: Figure 12 and Table 4 represent an interpreted version of information contained in BCA Specification C1.1. Direct reference to BCA is recommended.

### 2.6.4 Other Fire-resistance Requirements or Concessions

#### Class 9a Buildings

The BCA requires (Clause C2.5) patient care areas exceeding 1000 $\text{m}^2$ to be divided into floor areas of 1000 $\text{m}^2$ with fire-resistant walls of 60/60/60.

**Fire Walls**

In mixed classification, the ‘fire walls’ must have the highest Fire Resistance Level of the two adjoining parts, where there is a different in fire-resistant requirements.

**Separation of Classification**

Where there are two building classifications within the one storey, the highest Fire Resistance Level between the two classifications should be used, refer BCA Clause C2.8.

**Timber Columns in Single Storey Buildings**

Timber columns used in a building with a rise in storey of one, may use a timber column in its ‘fire or common wall’ as long as the Fire Resistance Level is not less than the required Fire Resistance Level of the ‘fire or common wall’.

Where it is used elsewhere in the building it is required to have an Fire Resistance Level of 30/-/- or the Fire Resistance Level required, refer BCA Spec C1.1, Clause 2.5 (b).
Step 3 – Selecting Fire-Rated Timber Construction Systems

This Step focuses on matching Deemed to Satisfy Fire Resistance Levels (FRLs) and related requirements with appropriate timber-framed construction. The Step focuses on Type C construction as this is where timber-framed fire-resistant construction is readily allowed.

The commentary begins by explaining key principles used in timber-framed construction to address fire 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-rated junctions between elements, penetrations in elements, stair construction details, and similar situations.

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

In the classes of buildings dealt with in this Guide there are two principal ways for dealing with fire-resistance; the first by the use of fire-rated linings and the second by the use of sacrificial charring of timber. In many cases the building may employ a combination of these and the principle of how they work is explained in the following.

3.1.1 Fire-Grade Linings Provide the Primary Source of Protection to Timber Elements

Fire-grade linings provide the primary source of fire-resistance to timber framing (Figure 13) as well as individual timber elements, beams and columns (Figure 14). Generally, the greater the number of layers, the greater the resistance to fire.

Additional measures, as handled under the following paragraphs, are required at weak spots or breaks in the fire-grade linings which occur at intersections between wall, floor and ceiling elements. Corner laps and exposed edges in lining sheets present another area of concern. Extra attention is also needed at penetrations, openings and protrusions.

Figure 13: Fire-grade lining protecting timber framing.
3.1.2 Selecting Tested Systems

This Guide does not describe the options available to protect timber framing or timber elements with fire-resistant linings. Most lining manufacturers have information and appropriate test or assessment reports to support the use of systems. In many cases the maximum Fire Resistance Level of wall and floors systems is limited to 120 minutes.

3.1.3 Sacrificial Charring Timber

In this case, timber itself is used as the protecting element. Wood when exposed to high temperatures will decompose to provide an insulating layer of char that retards further degradation of the wood. Initially it is rapid but as the char depth increases the char rate slows.

Charring rates are dependent on the timber density as well as the moisture content and are well known and predictable. As the moisture content of timber within a building is fairly stable, the timber density is used to predict the fire-resistance of large timber elements. The Australian Standard AS1720.4 Timber Structures – Fire-resistance of Structural Timber Members, a primary reference document in the BCA, provides a method to calculate the fire-resistant level of solid timber. This is explained further in Section 3.4.

Figure 14: Fire-grade linings protecting timber column.
3.2 Fire-Rated Wall Construction Systems

Timber framed construction can be described in terms of systems as depicted by the main wall, floor and ceiling elements, a skeletal section is shown in Figure 15.

![Post and beam timber construction](image)

*Figure 15: Post and beam timber construction.*

As explained previously in Sections 3.1, all the elements shown in Figure 15 are reliant on multiple layers of linings to attain the Fire Resistance Levels. Further detail on each individual element in the system is discussed below including reference to related drawings:

**Situation 1:** Fire-resistant single stud wall (Figure 16) mainly used for supporting fire-rated floors.

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

*Figure 16: Fire-rated internal timber stud wall – plan view.*
**Situation 2:** Fire-resistant external single stud clad wall (Figure 17) used where required to protect against an external fire source.

*Figure 17: Fire-rated external timber stud wall – plan view.*

**Situation 3:** Fire-resistant brick veneer external wall (Figure 18) used where required to protect against an external fire source.

*Figure 18: Fire-rated brick veneer wall – Plan view.*

**Situation 4:** Fire-resistant deep joisted floor (Figure 19). This construction can be easily upgraded to include non-mandatory sound insulation as well.

*Figure 19: Fire-rated timber-framed floor – elevation view.*
Situation 5: Smoke-proof walls (Figure 20).

NOTE: Lining panels for smoke-proof walls can alternatively be screw laminated.

Figure 20: Smoke-proof wall – elevation view.
Situation 6: In-plane post and beam construction (Figure 21).

Encasing timber adds to the natural protective effect of charring.

Figure 21a: In-plane post and beam construction – with oversized timber posts to achieve fire-resistance.

Figure 21b: In-plane post and beam construction – with encased timber posts to achieve fire-resistance.
**Situation 7:** Bulkhead post and beam construction (Figure 22).

*Figure 22a: Bulkhead post and beam construction – with oversized timber posts to achieve fire-resistance.*

*Figure 22b: Bulkhead post and beam construction – with encased timber posts and floor beams to achieve fire-resistance.*
3.3 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-resisting level of 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 23)
- Solid-timber blocks (Figure 23)
- Fire-resisting sealant (Figure 24).

![Figure 23: Fire-resistant mineral wool used to close a gap – plan view.](image)

![Figure 24: Fire-resistant sealant used to close a gap – elevation view.](image)

In some cases, you can use solid timber as an equivalent to fire-grade linings.

3.3.1 Solid Timber Construction Joints

Solid timber can also 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 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. Refer to Figure 25 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 this Guide.
Figure 25: Non-fire-rated walls abutting FRL 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 mm 0.7 BMT (Figure 26).

Figure 26: Timber sacrificial blocks used to close a gap for a FRL 90 minute system (note metal angle) – plan view.

The system is limited to fire-resistance of 90 minutes. Where fire-resistance greater than 90 minutes is required, continuous linings passing through the joint is recommended.

The following describes common locations and solution for where non-fire-rated elements abut fire-rated elements.

**Roof Framing Elements Supported off Fire-Rated Walls**

Similarly, where roof framing elements abut fire-rated walls they create openings that again can be sealed by the use of solid-timber blocks. Refer to Figure 27 for roof rafter and Figure 28 for roof trusses.
Mineral wool has many uses, but beware inferior products.

Figure 27: Rafter and ceiling joist supported off fire-rated wall – FRL 60 minutes – elevation view.

Figure 28: Fire-rated wall through to underside of truss roof – FRL 60 minutes – elevation view.
Where it is difficult to place fire-grade linings around trusses in the roof void, trusses can be support on girder truss off the wall (Figure 29).

**Figure 29: Alternative support detailing girder truss running parallel to wall, allowing access for wall lining installation – FRL 60 minutes – elevation view.**

**Internal Non-Fire-Rated Floors Abutting Fire-Rated Walls**

There are times when floors such as a mezzanine floor or floors protected by fire protected covering or Resistant to Incipient Spread of Fire ceilings may butt a fire-rated wall. In these cases, the same principle is used with timber blocks replacing fire-resistant linings, refer to Figures 30 and 31 for variations of the same detail.

**Figure 30: Non-fire-rated floor to wall junction – FRL 60 minutes – elevation view.**
Flooring not continuous under wall plate
Engineered timber floor joists
Engineered timber (floor trusses)
Additional noggings to support wall linings
Flexible fire-grade sealant
Flexible fire-grade sealant
Additional 45 mm solid-timber blocking (Timber blocks are to be bolted to studs)
Fire- and sound-rated linings

Figure 31: Non-fire-rated floor to wall junction, wall stud continuous through junction – FRL 60 minutes – elevation view.

**Floor Truss Top Chord Support Detail**

A common use of floor joists is floor trusses. This form of floor joist has the unique ability to be top chord supported. A similar support mechanism as the pocket described above can be used. Here only the top chord needs to be pocketed (Figure 32).

Figure 32: Floor truss top chord support in pocket – FRL 60 minutes – elevation view.
Non-Fire-Rated Internal Walls Meeting Fire-Rated Ceiling/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 the ceiling linings (Figure 33).

![Diagram of Non-Fire Wall Abutting Fire-Rated Floor/Ceiling Systems](image)

**Figure 33:** Non-fire wall abutting fire-rated floor/ceiling systems – elevation view.

Non-Fire-Rated Wall Abutting Fire-Rated Walls

This situation may occurs within a SOU 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 the linings (Figures 25 and 26).
Window, Door and Wall Cavities

There are many instances where doorways or openings penetrate through fire-rated walls. Examples include entrance doors, or external door or windows. These openings must be designed so that they do not become a weak link in the fire rating of the building.

In most cases, the door or window system is a fire-rated element and is required to have similar fire-resistance. In these cases the tested window or door system must be assessed to fit into the wall construction that it is placed in. The installation requirements of the manufacturer of the door or window system must then be followed.

Where there is no fire-rated wall or door requirement, it is recommended that the fire-grade lining used on the wall system is wrapped around the opening to maintain the fire-resistance (Figure 34).

![Figure 34: Section through an internal door opening in a fire-resistant wall.](image-url)
3.3.2 Junction Between Dissimilar Fire-Rated Elements

There are instances where lower rated elements abut higher rated elements, such as a fire wall abutting an external wall. 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 the junction to the highest fire-resistance, i.e. if there is a junction between 30 and 60 minutes elements, design the junction for 60 minutes.

Where the occurrence of mismatched fire rated elements is unavoidable, the principles of sacrificial timber blocking discussed in Section 3.3.1 can also be used. For these situations, the thickness of the timber blocks must be equal to the highest fire rating of abutting elements.

3.3.3 Junction Between Same Fire Resistance Levels Elements

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 consequently reference to the lining manufacturer is recommended.

3.4 Sacrificial Charring Timber

As discussed previously, there is a BCA referenced Standard AS 1720.4 Timber Structures – Fire-Resistance of Structural Timber Members – that provides a method to calculate a Fire Resistance Level for solid timber, including glulam and LVL. Common applications are columns and beams.

To calculate the charring depth the following is used:

**Notional Charring Rate**

\[ C = 0.4 + \frac{(280)}{D^2} \]

Where

- \( C \) = notional charring rate in mm/min
- \( D \) = timber density at a moisture content of 12 per cent in kg/m\(^3\)

Where the species density is not known (common occurrence as timber is generally not specified by species) the following densities can be used, hardwoods 800 kg/m\(^3\), softwood 550 kg/m\(^3\).

**Effective Depth of Charring**

\[ d_e = C \cdot t + 7.5 \]

Where

- \( d_e \) = calculated effective depth of charring in mm (Figure 35)
- \( C \) = notional charring rate in mm/min, calculated above
- \( T \) = period of time, in minutes.

![Figure 35: Effective charring depth.](image)
This process will give a depth of charring and consideration is required to the number of surfaces exposed (Figure 36). On each face exposed the charring of the timber is assumed to occur. The 7.5 mm in the Effective Depth of Charring calculation is to account for the transition zone between the char depth and the unaffected wood.

![Figure 36: Examples of faces of timber elements exposed to fire.](image)

### 3.4.1 Calculating Load Capacity of the Residual Element

As the fire-resistance obtained is only structural, the residual section size is used in calculating the fire design load capacity of the element. Structural engineers would calculate the section size required using a reduce load assumed for a fire event. Refer to AS1720.4 and AS1170.0 for further information on calculating load capacity.

**Hint:** To determine the minimum section size required, first calculate the minimum size required under the fire design load condition and then add effective charring depth to the dimension. Then choose next available timber size greater than this dimension.

### 3.4.2 Connectors

The major issue with the use of sacrificial timber is ensuring the connectors are not the weakest link. This can be achieved in two methods that are discussed below.

**Embedding Connectors**

Embedding the connector into the timber element so that all parts of the connector are below the calculated effective charring depth, found in the above. Timber plugs can be used to cover the connector, (Figure 37).

![Figure 37: Embedded connectors in the timber.](image)
**Sacrificial Cladding**

An alternative method is to cover the connector with timber greater in depth than the calculated effective charring depth. The additional timber needs to be fixed to the joint so that it does not separate from the joint under the affects of fire and movement at the joint, screws are recommended (Figure 38).

![Figure 38: Example of cladding used to protect connectors.](image)

**3.5 Ceilings Resistant to Incipient Spread of Fire**

In Class 5, 6, 9a and 9b buildings there are solutions that use a Resistant to Incipient Spread of Fire ceiling to the underside of the floor or roof framing. Here the ceiling is required to be continuous until it meets a fire-rated wall, external wall or other fire-rated element. Where non-rated walls are required to be connected to the floor joist or supports, this must be achieved so that the Resistant to Incipient Spread of Fire ceiling linings are not interrupted (Figure 39).

![Figure 39: Internal wall fixings through Resistant to Incipient Spread of Fire ceiling – elevation view.](image)

**3.6 Plumbing, Electrical Service and Mechanical Ventilation Penetrations in Fire-Resistant 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. This method details a number of elements such as pipes, and cables and gives solutions for sealing these penetrations.
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 if required. As these systems are propriety and no further discussion is made. Refer to Figures 40 and 41 for examples of such propriety systems. In general, all penetrations 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.

![Diagram of plumbing service penetration in fire- and sound-rated wall and floor/ceiling – elevation view.](image1)

**Figure 40: Plumbing service penetration in fire- and sound-rated wall and floor/ceiling – elevation view.**

In many cases, dealing with penetrations in fire-rated elements can be avoided by placing in external non-rated systems (Figure 42) or by building false walls or boxes creating pockets in the fire-rated element (Figure 43).

![Diagram of electrical service penetration in fire-rated floor/ceiling.](image2)

**Figure 41: Electrical service penetration in fire-rated floor/ceiling.**

In many cases, dealing with penetrations in fire-rated elements can be avoided by placing in external non-rated systems (Figure 42) or by building false walls or boxes creating pockets in the fire-rated element (Figure 43).

![Diagram of false wall for services, e.g. Bathrooms – elevation view.](image3)

**Figure 42: False wall for services, e.g. Bathrooms – elevation view.**

With penetrations, prevention can be better than cure!
Figure 43: Timber framing details for recessed light in fire-rated floor/ceiling.
3.7 Non-Fire-Isolated Stairways

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 laminated, 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-grade linings, as required for the floor systems, under the stairs as an offset for the less fire-resistant Deemed to Satisfy construction solution (Figure 44).

![Possible Alternative Solution option for stairs – elevation view.](image)

3.8 Smoke-Proof Walls For Class 9a

The BCA requires smoke-proof walls for Class 9a buildings to be non-combustible. This excludes timber framing but easy solution can be the use of laminated plasterboard (Figure 45) or shaft wall (Figure 46).
Figure 45: Laminated plasterboard smoke-proof wall – elevation view.

Figure 46: Shaft wall smoke-proof wall.
3.9 Strategies for Upgrading Sound Performance in Floor Construction

Although there is no sound requirement for floors in the range of buildings dealt with in this Guide, building occupants often want high sound performance for floors. 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. Options for upgrading typical construction are provided below, and it is not just that one option that will give the best performance but, most likely, a combination of options.

3.9.1 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 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.** 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 or ceiling levels.

- **Using absorptive materials to fill wall and floor cavities** (cellulose fibre, glass fibre or mineral wall) 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.

3.9.2 Floors Systems

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 or travelling from below upwards. They help reduce sound transference 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 47).

![Figure 47: Upgraded sound-resilient ceiling mounts – elevation view.](image-url)
3.9.3 Increasing Mass of the Top Layer of Floor Systems

Sand used to increase mass in timber floors. This increases the mass of the upper layer of the floor element and the air spaces between the sand particles serve to help the vibration and energy created by impact sound from footfall to be reduced.

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). In between the battens a dry sand layer is placed to just below the surface of the final floor sheet. The final floor sheet is fixed over in the normal manner and floor covering placed on this (Figure 48).

Concrete topping. This increases the sound-insulation performance of the floor system by increasing the mass. Typically this can be achieved with a 35 to 45 mm thick layer of concrete placed over an isolating mat. Care is required to upturn the isolating mat at the perimeter of the topping with the wall otherwise the affect of the topping is negated (Figure 49).
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, but does provide some additional sound deadening (Figure 50).

![Diagram of Extra Sheet Flooring](image)

**Figure 50:** Additional sheet flooring to improve acoustic performance of the floor.

In all of the options above the additional construction will add height to the floor system. Consideration of the effect this height has on other issues such as wet areas, corridors, door sets and stairs is needed at the planning stage.

### 3.9.4 Separate Floor and Ceiling Frame

By having two sets of joists (separate floor and ceiling joists) which are nested between each other but not touching each other, it is possible to isolate the two structures thus 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 51).

![Diagram of Separate Floor and Ceiling Frame](image)

**Figure 51:** Separate ceiling and floor joist structures – elevation view.

Adding floor mass adds height. This must be planned for at the outset.
3.9.5 **Isolated Support for Stairs**

Impact sound from stair usage typically vibrates its way into walls dividing Sole Occupancy Units (SOUs), thereby 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 at top and bottom flight rather than the wall between dwellings (Figure 52); and
- using decorative posts to support the stair structure rather than the wall between dwellings.

*Figure 52: Isolated support for stairs – elevation view.*
Step 4 – Further Design Assistance (Appendices)

The previous Steps in the Guide require consideration of additional information on topics closely linked to the design of fire construction. The following appendices cover structural design considerations, site inspection of timber-framed construction, 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 5, 6, 9a and 9b 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 (2002) 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 of 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>C1.1</td>
<td>Type of Construction</td>
<td>Yes – refer Section 3.2</td>
</tr>
<tr>
<td>C1.2</td>
<td>Calculating the ‘rise in storeys’</td>
<td>No</td>
</tr>
<tr>
<td>C1.3</td>
<td>Buildings of multiple classification</td>
<td>Yes – refer Section 3.3</td>
</tr>
<tr>
<td>C1.4</td>
<td>Mixed types of construction</td>
<td>Yes – refer Section 3.5</td>
</tr>
<tr>
<td>C1.5</td>
<td>Two storey Class 2, 3 or 9c buildings</td>
<td>No – refer Class 2, 3 and 9c Guide</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</td>
</tr>
<tr>
<td>C1.09</td>
<td>Blank item in BCA</td>
<td>No</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>
</tbody>
</table>
Table B2: Checklist for BCA Part C2: Compartmentalisation and Separation.

<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>C2.0</td>
<td>Deemed to Satisfy Provisions</td>
<td>Yes</td>
</tr>
<tr>
<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 – but may be relevant</td>
</tr>
<tr>
<td>C2.3</td>
<td>Large isolated buildings</td>
<td>No – but may be relevant</td>
</tr>
<tr>
<td>C2.4</td>
<td>Requirements for open spaces and vehicular access</td>
<td>No – but may be relevant</td>
</tr>
<tr>
<td>C2.5</td>
<td>Class 9c buildings</td>
<td>No – but relevant to Class 9c buildings, refer Class 2.3 and 9c Guide</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>Yes – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
<tr>
<td>C2.8</td>
<td>Separation of classifications in the same story</td>
<td>Yes – refer to Section 2.5</td>
</tr>
<tr>
<td>C2.9</td>
<td>Separation of classifications in different stories</td>
<td>Yes – refer to Section 2.5</td>
</tr>
<tr>
<td>C2.10</td>
<td>Separation of lift shafts</td>
<td>No – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
<tr>
<td>C2.11</td>
<td>Stairways and lifts in one shaft</td>
<td>No</td>
</tr>
<tr>
<td>C2.12</td>
<td>Separation of equipment</td>
<td>No – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
<tr>
<td>C2.13</td>
<td>Electricity supply system</td>
<td>No – designer to interpret relevance then if required, select an appropriately rated timber detail</td>
</tr>
<tr>
<td>C2.14</td>
<td>Public corridors in Class 2 and 3 of buildings</td>
<td>No – refer to Class 2, 3 and 9c Guide</td>
</tr>
<tr>
<td>BCA Clause</td>
<td>Issue</td>
<td>Is assistance on this issue provided in this publication</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>C3.0</td>
<td>Deemed to Satisfy Provisions</td>
<td>Yes</td>
</tr>
<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>
</tr>
<tr>
<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 may be relevant to a building design</td>
</tr>
<tr>
<td>C3.6</td>
<td>Sliding fire door</td>
<td>No – but may be relevant to a building design</td>
</tr>
<tr>
<td>C3.7</td>
<td>Protection of doorways in horizontal exits</td>
<td>No – but may be relevant to a building design</td>
</tr>
<tr>
<td>C3.8</td>
<td>Openings in fire–isolated exits</td>
<td>No – but may be 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</td>
</tr>
<tr>
<td>C3.11</td>
<td>Bounding construction: Class 2, 3 and 4 buildings</td>
<td>No</td>
</tr>
<tr>
<td>C3.12</td>
<td>Openings in floors and ceilings for services</td>
<td>No</td>
</tr>
<tr>
<td>C3.13</td>
<td>Opening in shafts</td>
<td>No</td>
</tr>
<tr>
<td>C3.14</td>
<td>No requirements</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 3.3.1</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>
</tbody>
</table>

Table B3: Checklist for BCA Part C3: Protection of Openings.
Appendix C – References

Design References

Australian Building Codes Board

- Building Code of Australia (BCA) 2009 – Volume 1 & 2

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
- #02 Timber-Framed Construction for Multi-Residential Buildings Class 2, 3 and 9c – Design and construction guide for BCA compliant sound – and fire-rated construction

Test and Assessment Reports

Bodycote Warringtonfire (Aus)


Exova Warringtonfire Australia

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
- 13 mm fire-grade plasterboard; or
- 12 mm cellulose fibre-reinforced cement sheeting complying with AS 2908.2; or
- 12 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.
If you’re looking to design or build a commercial, residential or industrial project - discover WoodSolutions, the website that’s designed and constructed for you.

WoodSolutions is a world-leading initiative and a one stop source for a huge range of free, non-proprietary information, including:

- Technical Design Guides
- case studies
- workplace technical presentations
- conferences and seminars
- species information
- performance data
- fire information
- durability ratings
- fixings and finishes
- Standards and Codes, and much more.

Developed by the Australian forest and wood products industry, WoodSolutions contains information from industry bodies, manufacturers and suppliers.

Visit the WoodSolutions website today and build your knowledge.
Discover more ways to build your knowledge of wood

If you need technical information or inspiration on designing and building with wood, you’ll find WoodSolutions has the answers. From technical design and engineering advice to inspiring projects and CPD linked activities, WoodSolutions has a wide range of resources and professional seminars.

**www.woodsolutions.com.au**

Your central resource for news about all WoodSolutions activities and access to more than three thousand pages of online information and downloadable publications.

**Technical Publications**
A suite of informative, technical and training guides and handbooks that support the use of wood in residential and commercial buildings.

**WoodSolutions Tutorials**
A range of practical and inspirational topics to educate and inform design and construction professionals. These free, CPD related, presentations can be delivered at your workplace at a time that suits you.

**Seminars and Events**
From one day seminars featuring presentations from leading international and Australian speakers to international tours of landmark wood projects, WoodSolutions offer a range of professional development activities.

**What is WoodSolutions?**
Developed by the Australian forest and wood products industry for design and building professionals, WoodSolutions is a non-proprietary source of information from industry bodies, manufacturers and suppliers.