

# 6

## 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, 3 and 9c 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.

*Taller buildings mean more wind and greater loads.*

*Seasoned or engineered timber can minimise shrinkage in higher structures.*

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).
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## 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.**

BCA Clause	Issue	Is assistance on this issue provided in this publication
C1.0	Deemed to Satisfy Provisions	Yes
C1.1	Type of Construction	Yes – refer Section 4.2
C1.2	Calculating the 'rise in storeys'	No
C1.3	Buildings of multiple classification	No
C1.4	Mixed types of construction	No
C1.5	Two storey Class 2, 3 or 9c buildings	Yes – refer Section 4.2
C1.6	Class 4 parts of buildings	No
C1.7	Open spectator stands and indoor sports stadiums	No
C1.8	Lightweight construction	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
C1.09	No requirements in the BCA	NA
C1.10	Fire hazard properties	No – advice on suitable species and application can be found on <a href="http://www.timber.net.au">www.timber.net.au</a>
C1.11	Performance of external walls in the fire	No – This item only applies to concrete external walls
C1.12	Non-combustible materials	No – Not necessary but note that plasterboard and fibre-cement sheets are deemed non-combustible

**Table B2: Checklist for BCA Part C2: Compartmentalisation and Separation.**

<b>BCA Clause</b>	<b>Issue</b>	<b>Is assistance on this issue provided in this publication</b>
<b>C2.0</b>	Deemed to Satisfy Provisions	Yes
<b>C2.1</b>	Application of Part	Yes – general information on relevant clauses required to be considered for a design
<b>C2.2</b>	General floor area and volume limitations	No – but maybe relevant to Class 9c buildings
<b>C2.3</b>	Large isolated buildings	No – but maybe relevant to Class 9c buildings
<b>C2.4</b>	Requirements for open spaces and vehicular access	No – but maybe relevant to Class 9c buildings
<b>C2.5</b>	Class 9a and 9c buildings	Yes – Class 9c buildings
<b>C2.6</b>	Vertical separation of openings in external walls	Yes – designer to interpret relevance then if required, select an appropriately rated timber detail
<b>C2.7</b>	Separation by firewalls	No – designer to interpret relevance then if required, select an appropriately rated timber detail
<b>C2.8</b>	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
<b>C2.9</b>	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
<b>C2.10</b>	Separation of lift shafts	No – designer to interpret relevance then if required, select an appropriately rated timber detail
<b>C2.11</b>	Stairways and lifts in one shaft	No
<b>C2.12</b>	Separation of equipment	No – designer to interpret relevance, then if required, select an appropriately rated timber detail
<b>C2.13</b>	Electricity supply system	No – designer to interpret relevance, then if required, select an appropriately rated timber detail
<b>C2.14</b>	Public corridors in Class 2 and 3 of buildings	Yes – go to Section 5.10.1

**Table B3: Checklist for BCA Part C3: Protection of Openings.**

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

# Appendix C – Design 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.
- AS1684 – Residential Timber Framed Construction Standard.
- 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](http://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.

## Test and Assessment Reports

### Bodycote Warringtonfire (Aus)

- 22567A Assessment Report: The likely fire resistance performance of timber-framed walls lined with plasterboard if tested in accordance with AS 1530.4 2005, September 2008.
- 22567B Assessment Report: The likely fire resistance performance of MRTFC wall floor junctions if tested in accordance with AS 1530.4 2005, September 2008.
- RIR 22567B Regulatory Information Report: The likely fire resistance performance of MRTFC wall floor junctions if tested in accordance with AS 1530.4 2005, September 2008.
- 2256701 Test Report: Fire resistance test of a timber wall floor junction in general accordance with AS 1530.4 2005, September 2008.
- 2256702 Test Report: Fire resistance test of a wall beam junction when tested in general accordance with AS 1530.4 2005, September 2008.

### Exova Warringtonfire Australia

- 2365300 Test Report: Fire resistance test of floor junctions incorporating timber and plasterboard in general accordance with AS 1530.4 2005, November 2009.
- 2365400 Test Report: Fire resistance test of floor junctions incorporating timber and plasterboard in general accordance with AS 1530.4 2005, November 2009.
- 2365500 Test Report: Fire resistance test of floor junctions incorporating timber and plasterboard in general accordance with AS 1530.4 2005, November 2009.

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# 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.

*Ensure your sealants have the same fire rating as the materials they seal.*

### **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 1160° 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<sub>w</sub>**

Refer to Weighted sound reduction index.

**Unit**

Sole-Occupancy unit.

**Weighted sound reduction index (R<sub>w</sub>)**

The rating of sound insulation in a building or building element as described in AS/NZS 1267.11999.





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