



Good Practice Guide

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Fire Resistance

Version 1

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FIRE PROTECTION ASSOCIATION AUSTRALIA





Fire Resistance

Leading and supporting a professional industry to minimise the impact of fire on life, property and the environment, for a safer community.

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1.0 Purpose

The purpose of this document is to provide guidance and information on:

1. The general requirements for fire-resisting construction under Volume 1 of the Building Code of Australia; and
2. Why such fire resistance is required.

2.0 Audience

This Good Practice Guide is intended for:

- (i) building owners, building managers and strata corporation managers, occupiers, tenants and the like;
- (ii) Building structural and services engineers, designers, consultants, and the like;
- (iii) Builders, trade service contractors and the like;
- (iv) fire protection companies that design, manufacture, supply, install and routinely service fire resisting systems; and
- (v) other stakeholders with an interest in fire protection (fire brigades, insurers, councils, building certifiers/surveyors, architects, etc.).

3.0 Introduction

This introductory guide is the first part of a series of passive fire protection guides developed by FPA Australia and covers the fundamentals of passive fire protection. Future guides will focus on specific fire protection systems, equipment and items.

This guide explains:

- What fire resistance is
- What a fire-resistance level (FRL) and fire-resisting building element is;
- What a fire compartment is and why it is important;
- What the general BCA Volume 1 requirements for fire-resistant building construction are;
- How you determine the FRL of a fire-resisting building element;
- What the evidence of suitability and documentation requirements are; and
- Who is responsible for ensuring that fire-resisting construction is compliant.

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4.0 Terminology

The building industry typically uses a variety of terminology with regards to fire-resistance and fire-resisting building elements. Therefore, this guide also incorporates this terminology to assist understanding.

<u>Terminology</u>	
BCA Terminology	Also known as:
Protection method	Fire stopping, fire seal system
Fire resisting	Fire rated, fire-resistant, fire resisting construction
Fire compartment	Fire compartmentation
Prototype assembly	Tested Specimen
Building element required to have an FRL	Fire-resistant building element
Other Terminology	Also known as:
Building Surveyor	Building Certifier, Principal Certifying Authority
	Authority Having Jurisdiction

5.0 Background

Passive fire protection is the use of fire-resisting building elements to prevent the spread of fire and prevent structural collapse. When properly installed, maintained and routinely serviced, passive fire protection improves life safety and provides property protection.

There are three main areas of passive fire protection:

- **Structural fire protection:** Structural fire protection protects essential structural loadbearing building elements (such as beams, columns, walls and the like) from the effects of fire so that they provide the required level of structural adequacy to maintain structural stability for a required duration.
- **Compartmentation:** Fire-resisting building elements (such as firewalls, fire rated floors, fire rated shafts, fire rated stairways, fire rated floors and smoke barriers) are all used in compartmentation. They are used as barriers to restrict the spread of fire in a building by containing it to specific areas, thereby providing occupants time to evacuate in the event of a fire.
- **Protection of openings:** Openings in fire-resisting building elements are commonly made to allow for the movement and transport of occupants, goods and trade services within a building. These openings are required to be protected by devices, equipment and materials that limit fire spread to retain the level of fire-resisting performance of the building element.

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This section outlines the key concepts behind fire-resistance levels and the purpose of fire-resisting building elements before exploring the three main areas of passive fire protection in greater detail.

5.1 Fire-resistance level

A fire-resistance level (FRL) is the BCA criterion used to quantify a building element or method of construction's required fire-resisting performance (in minutes).

As shown in the diagram below, there are three criteria for an FRL: Structural Adequacy/ Integrity/Insulation. The FRL is expressed in that order, for example: 60/60/60. The red text in the diagram denotes the number sequence relevant to the FRL criteria.

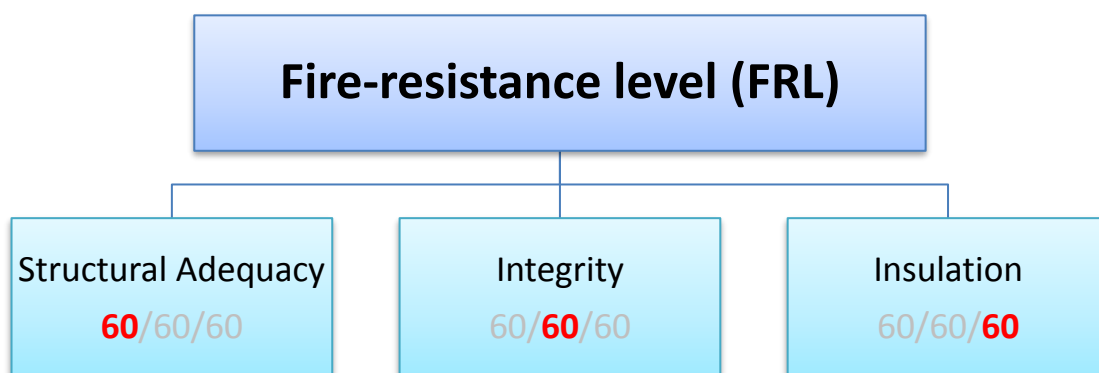


Figure 1 Fire-resistance level

A dash is used where there is no requirement for that criterion, for example: -/60/60 indicates there is no requirement for structural adequacy.

Each of the three criteria of the FRL is a grading period, in minutes, determined by testing a prototype assembly—consisting of a representative specimen of a building element, protection method or method of construction—to the standard time temperature curve regime prescribed in Australian Standard AS 1530.4.

Each of the FRL criteria (and their associated test fail conditions) is described in detail as follows and illustrated in Figure 2 below:

(a) Structural adequacy

This is the ability to maintain stability and adequate loadbearing capacity in the event of a fire.

Failure in relation to structural adequacy shall be deemed to have occurred upon collapse; dislodgement or detachment of any part; or, deflection in excess of what is acceptable under AS 1530.4.

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(b) Integrity

This is the ability to resist the passage of flames and hot gases.

Failure in relation to integrity shall be deemed to have occurred upon collapse or the development of cracks, fissures or other openings through which flames and hot gases can pass.

(c) Insulation

This is the ability to maintain a temperature, on the surface not exposed to the furnace, below the limits specified in AS 1530.4.

Failure in relation to insulation shall be deemed to have occurred when the temperature on the unexposed side of the specimen exceeds the limits specified in AS 1530.4.

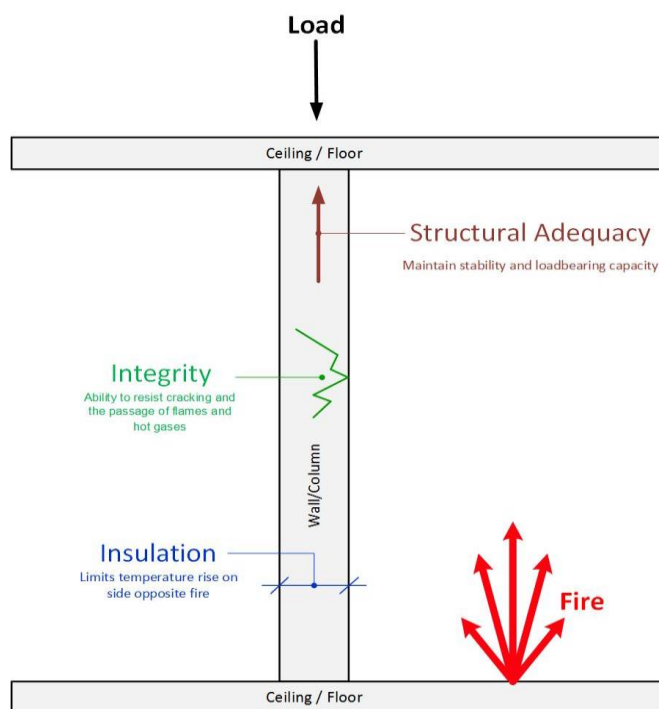


Figure 2 Fire-resistance level

Note: Fire-resistance levels (FRLs) are typically shown in 30 minutes intervals—e.g. 30/30/30, 60/60/60, 90/90/90, etc.—because the Building Code of Australia refers to FRLs in these intervals.

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It is important to note that the time period achieved by the specimen in the test does not reflect or guarantee the equivalent time period of the building element or method of construction in any future fire incident. It simply serves as a consistent methodology for comparison of the performance of fire-resisting building elements and methods of construction.

5.2 Fire-resistant building elements

Fire-resisting building elements may be required to perform either or both of two distinct functions with regards to resisting a fire. Firstly, load bearing structural elements are required to retain adequate strength or loadbearing capacity during a fire. Secondly, elements may be required to provide a separating or isolating function (fire compartment, fire-isolated stairway and the like).

For example, fire-resisting building elements can be structural loadbearing building elements (such as beams, columns, walls, floors and the like) or non-loadbearing building elements. However, either type of element can be used to encompass an area to create a fire compartment.

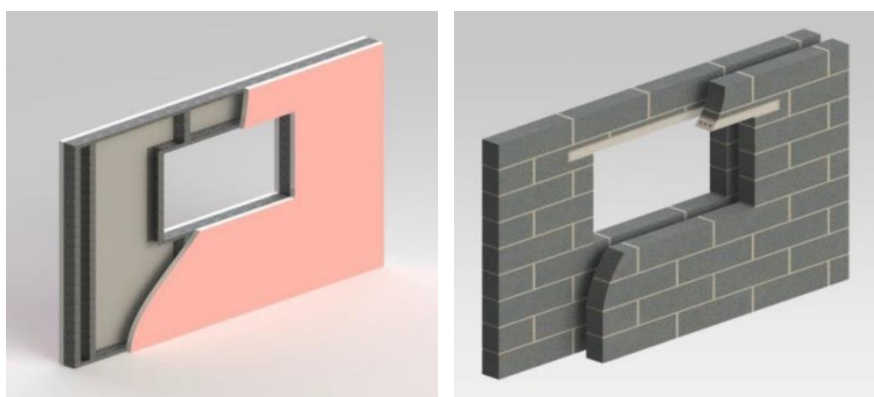


Figure 3 Examples of fire-resisting building elements (walls)

Fire-resisting building elements are a deliberate part of safe construction designed and installed with the intent of preventing structural collapse and the spread of fire to provide time for the evacuation of the building in the event of a fire.

Fire-resisting building elements are elements that:

- (i) Can prevent the spread of fire between buildings;
- (ii) Support fire brigade intervention;
- (iii) Can reduce the extent of property damage by restricting the spread of fire; and
- (iv) Often form part of a passive fire protection system.

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Depending on the building size and use (class) there may not be a requirement to install active fire protection systems (such as, smoke detection systems, smoke hazard management systems or fire sprinkler systems) to complement the required passive fire protection systems. Where a building is not required to have these active systems installed, reliance on passive fire protection systems to limit fire spread and provide time for evacuation becomes critical.

5.3 Structural fire protection

Structural fire protection protects loadbearing building elements (beams, columns, walls, floors and the like) from the effects of a fire for a specific time. During this time, the element is required to continue to maintain structural adequacy and provide the required loadbearing capacity.

This protection is typically accomplished by the application of a fireproofing material (spray-on thin-film intumescent coatings, endothermic materials like gypsum-based plasters and cementitious products, mineral wool wraps and insulation, and fireproofing cladding) or building the loadbearing building elements using concrete products.

5.4 Compartmentation

In the context of this document, fire compartmentation is the division of a building into individual areas (compartments) separated by fire-resisting building elements in order to contain or delay the spread of fire.

This division is shown in Figure 4 which shows five different areas separated by fire-resisting building elements.

Section A1.1 of the BCA Volume 1 defines a fire compartment as follows:

Fire compartment means—

- (a) The total space of a building; or
- (b) When referred to in—
 - (i) the *Performance Requirements* — any part of a building separated from the remainder by barriers to fire such as walls and/or floors having an appropriate resistance to the spread of fire with any openings adequately protected; or
 - (ii) the *Deemed-to-Satisfy Provisions* — any part of a building separated from the remainder by walls and/or floors each having an FRL not less than that *required* for a *fire wall* for that type of construction and where all openings in the separating construction are protected in accordance with the *Deemed-to-Satisfy Provisions* of the relevant Part.

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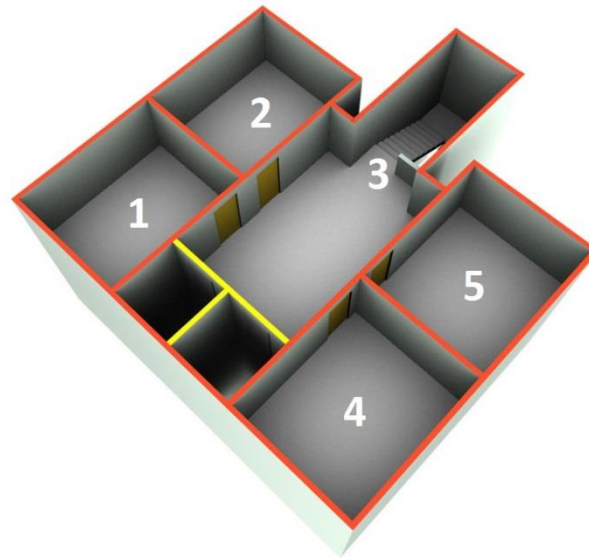


Figure 4 Example of compartmentation (red indicates fire-resistant building elements for the compartments and fire-isolated stairs; whereas yellow indicates non-fire-resisting construction of some storage rooms that are not fire compartments)

This division of a building into fire compartments is achieved through a combination of fire-resisting building elements (walls, floors and ceilings) that are constructed to achieve a stipulated FRL required by the BCA Deemed-to-Satisfy Provisions or as required by a Performance Solution. These elements are often made of concrete, a combination of wood and gypsum, or masonry.

5.5 Protection of openings

Openings in fire-resisting building elements (such as doors, windows, voids and service penetrations) are made to allow for the movement and transport of occupants, goods and trade services within a building. Protection of these openings is extremely important and required by the BCA to ensure they do not reduce the fire-resisting performance of the fire-resisting building elements.

Fire doors, fire shutters, fire dampers, fire windows, fire collars, fire pillows, sealants and the like are common protection methods used for openings through fire-resisting building elements.

Failure to protect or correctly protect these openings will likely result in the premature failure of the fire-resisting building element containing the opening and therefore the fire compartment.

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6.0 Building Code of Australia requirements

The Building Code of Australia (BCA)—Volumes 1 and 2 of the National Construction Code (NCC)—details the Performance Requirements for new construction of buildings (or within existing buildings) in Australia. The BCA is adopted by legislation in all states and territories in Australia.

The BCA has Performance Requirements that must be met by complying with:

- (a) A Deemed-to-Satisfy Solution;
- (b) A Performance Solution (previously known as Alternative Solution); or
- (c) A combination of the two.

Because Performance Solutions are uniquely tailored to individual buildings, this guide focusses on the BCA Deemed-to-Satisfy Solution requirements for fire-resisting construction.

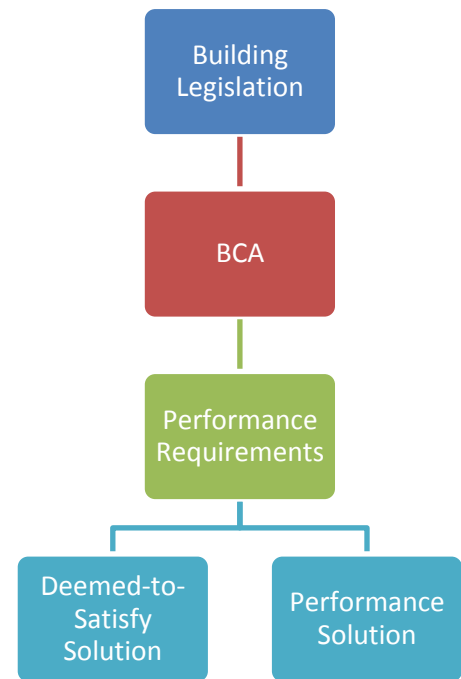


Figure 5 Building Code of Australia requirements

Note: This section includes an overview of the relevant BCA requirements. Please refer to the BCA itself for the full details of these requirements.

Access to the National Construction Code (including the BCA) is now freely available. Visit www.abcb.gov.au to register for this free access.

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6.1 BCA requirements for fire-resisting building elements

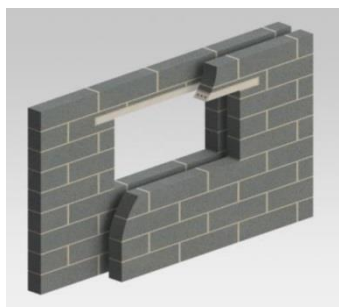


Figure 6 Example of fire-resisting building element (wall)

Volume One of the Building Code of Australia (BCA) states that compliance with the National Construction Code (NCC) is achieved by satisfying the Performance Requirements. In Section C Fire Resistance, there are nine Performance Requirements—CP1 to CP9—which must be satisfied.

In buildings, the use of fire-resisting building elements (such as, walls, floors, roofs and the like in buildings) is a deliberate part of safe construction prescribed by the BCA Deemed-to-Satisfy (DTS) Provisions for the purpose of restricting the spread of fire to provide time for the evacuation of the building in the event of a fire.

To comply with Section C Fire Resistance of Volume One of the BCA, the nine Performance Requirements—CP1 to CP9—must be satisfied. The aims of these Performance Requirements are detailed in the table below.

Table 1 – BCA, Volume 1, Section C Fire Resistance – Performance Requirements

Performance Requirement	Aim
CP1	Maintaining structural stability
CP2	Avoiding the spread of fire
CP3	Providing protection from fire and smoke for evacuation
CP4	Maintaining tenable conditions during evacuation
CP5	Avoiding outward collapse of concrete external panel walls
CP6	Avoiding spread of fire from service equipment having a high fire hazard
CP7	Avoiding spread of fire to emergency equipment
CP8	Protecting openings and service penetrations to maintain performance
CP9	Providing access to and around building for fire brigade intervention

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The Deemed-to-Satisfy (DTS) Provisions in Section C of the BCA Volume 1 that are used to meet these Performance Requirements consist of three parts (C1, C2 and C3) and eight specifications as shown in Figure 7 below. Clauses within these parts are denoted by those prefixes. For example the C2 in Clause C2.2, means that this clause is located in Part C2. Specifications (e.g. Specification C1.1) predominantly relates to clause the referenced (e.g. C1.1) but specifications may also be referenced in other clauses in the BCA.

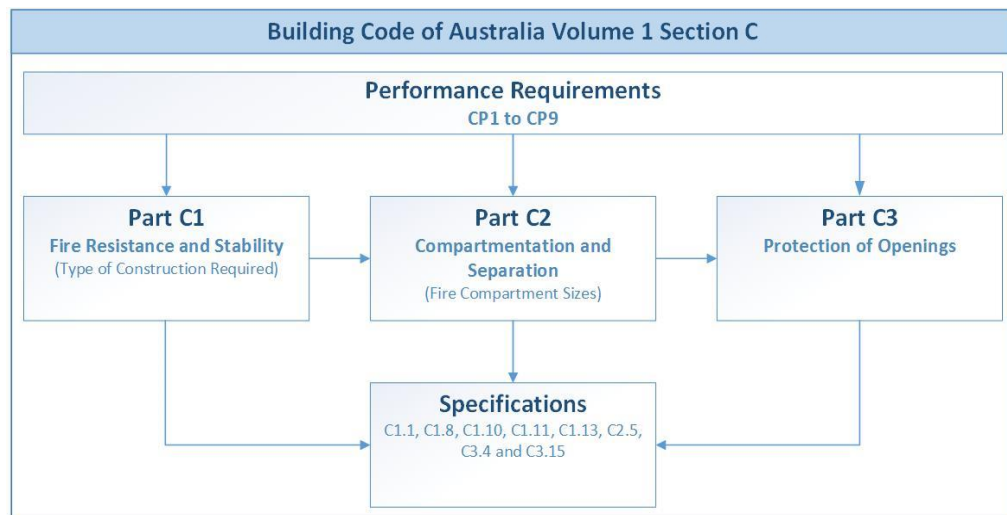


Figure 7 BCA Volume 1 Section C Parts

Part C1 details the specific requirements for fire-resistance and stability. Part C2 details the specific requirements for fire compartmentation and separation (providing requirements for fire compartments, fire-resisting building elements and the like and therefore, further details on exactly where fire-resisting construction is required). Part C3 details the specific requirements for the protection of openings.

6.2 Type of construction

In the Deemed-to-Satisfy Provisions of the BCA, Clause C1.1 “Type of Construction Required” details the required type of fire-resisting construction for Class 2 to 9 buildings based on the class of building (refer to BCA Part A3) and the buildings’ rise in storeys (refer to BCA Table C1.1).

There are three types of construction—Type A, B or C—where Type A is the most fire-resistant and Type C is the least fire-resistant type of construction.

The type of construction required based on class and storeys is summarised in Figure 8 below.

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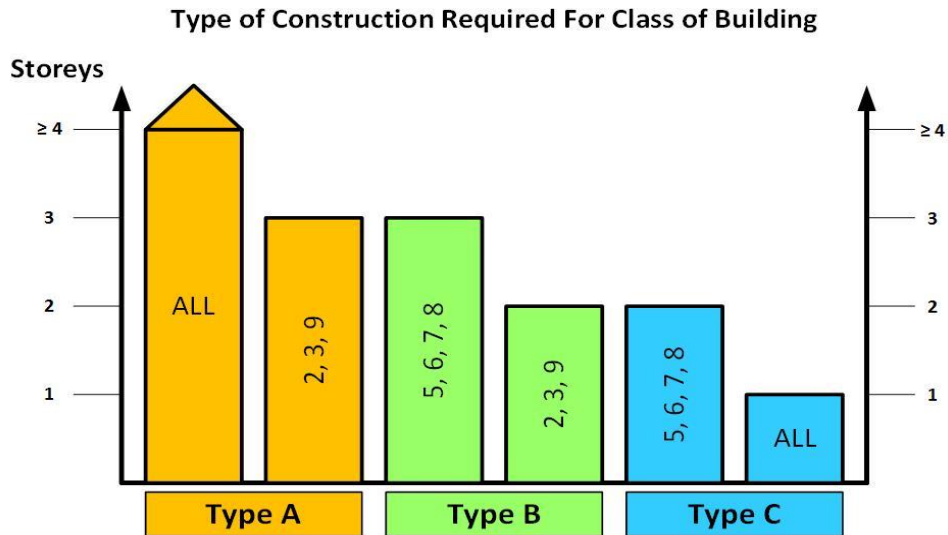


Figure 8 Types of Construction Required

Example

A Class 5 building must be at least Type C at up to 2 storeys, Type B at 3 storeys and Type A at 4 or more storeys whereas a Class 2 building must be at least Type C at 1 storey, Type B at 2 storeys and Type A at 3 or more storeys.

Specification C1.1 details different fire-resistance requirements for each of the three types of construction (Type A, B and C). This includes the FRLs required for various building elements such as:

- external walls
- external loadbearing columns
- common walls and fire walls
- different types of internal walls, such as:
 - walls of lift and stair shafts
 - walls bounding public corridors, public lobbies and the like
 - walls between and bounding sole-occupancy units, and
 - walls of ventilating, pipe, garbage and like shafts.
- other loadbearing internal walls, internal beams, trusses and columns
- floors
- roofs.

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However, while BCA Clause C1.1, Table C1.1 and Specification C1.1 detail the general Deemed-to-Satisfy requirements for fire-resisting construction within buildings it should be recognised that clauses in Section C (including Specification C1.1 and the like) modify or provide further specific requirements for what is required for certain classes of buildings, building elements and certain situations.

7.0 Documentation Requirements

7.1 Evidence of suitability

7.1.1 Overview

As previously mentioned, the Performance Requirements of the Building Code of Australia (BCA) Volume One can be met by complying with a Deemed-to-Satisfy Solution, a Performance Solution or a combination of the two.

To verify compliance with these solutions, documented evidence is required to demonstrate that the materials, forms of construction or designs used are “fit for purpose” and meet the Performance Requirements. Such documentation is referred to as “evidence of suitability”.

The requirements for evidence of suitability are detailed in Part A2 of the BCA “Acceptance of Design and Construction”.

Clause A2.1 of the BCA “Suitability of materials” requires that “Every part of a building must be constructed in an appropriate manner to achieve the requirements of the BCA, using materials that are fit for the purpose for which they are intended”.

Clause A2.2 of the BCA “Evidence of suitability” further expands on this by detailing in Clause A2.2(a) the types of evidence that may be used to support that the use of a material, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision.

These include:

- A report from a Registered Testing Authority
- A Certificate of Conformity or Certificate of Accreditation
- A certificate from a Professional Engineer or other appropriate qualified person
- A certificate issued by a certification body accredited by JAS-ANZ

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- Any other form of evidence that correctly describes the properties and performance of the material or form of construction and adequately demonstrates its suitability for use in the building.

See FPA Australia’s Position Statement PS-05 Product compliance and evidence of suitability (available at www.fpa.com.au) for more information on these options.

It is important to note that Clause A2.2(a) begins with “Subject to A2.3 and A2.4...”. Both A2.3 “Fire-resistance of building elements” and A2.4 “Fire hazard properties” are both specific passive fire protection clauses in the BCA which relate to evidence of suitability. Therefore, where Clause A2.3 or A2.4 is applicable, then the requirements of Clause A2.3 or A2.4 must also be met to satisfy Clause A2.2(a).

7.1.2 Acceptance of evidence of suitability

As with almost all building works throughout Australia, it is the responsibility of the relevant Authority Having Jurisdiction (Building Surveyor, Building Certifier, Principal Certifying Authority and the like) to determine from Part A2 of the BCA—with some exceptions—the required and appropriate type of evidence of suitability for different materials, forms of construction, designs or products.

However, in some instances (such as Clause A2.3 of the BCA), the required type of evidence of suitability is stipulated and therefore is not optional.

Report from a Registered Testing Authority

Passive fire protection systems are required to comply with the BCA and any referenced standards. Compliance often—if not always—requires that the evidence of suitability to support that they are fit for purpose and meet the performance requirements is to be provided in the form of a report from a Registered Testing Authority (RTA). These reports provide the results of the fire tests of the material, equipment, system of the like.

Reports required to be provided by RTAs can be provided in two different formats:

- **Test report**—This is the full report of the test and includes some information that is relevant only to the manufacturer and RTA.
- **Regulatory information report (RIR)**—This is an abbreviated version of the test report and includes only that information required for regulatory compliance.

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Test certificates can also be provided by the RTA. These are highly abbreviated versions of the test report and include only the most basic information (that the test was conducted and the FRL achieved). These are typically only used for marketing purposes.

A test certificate is not suitable evidence for regulatory compliance and is not suitable evidence of suitability under the BCA. However, both the test report and RIR are suitable (this is supported in the Guide to the Volume 1 of the BCA).

The test reports and regulatory information reports both include sufficient information to be used as evidence of suitability under the BCA. However, it is important to recognise that the test report is extremely comprehensive and could include intellectual property from which a competitor could replicate the manufacturer's product. FPA Australia considers that the provision of a RIR is sufficient evidence of suitability.

7.2 Fire-resisting building element documentation (notation, colours and registers)

In addition to the evidence of suitability, FPA Australia recommends that the designed and installed location of fire-resistant building elements be provided/recorded and kept as baseline data to ensure that any persons carrying out future works in the building can easily and readily identify the location and type of fire-resisting building elements.

Colour Coding and Annotation

FPA Australia recommends that architects, draftspersons and the like use the colour coding and annotation as shown in Figure 9 to detail fire-resisting building elements or construction, smoke walls and resistance to the incipient spread of fire. This will provide consistency of documentation.

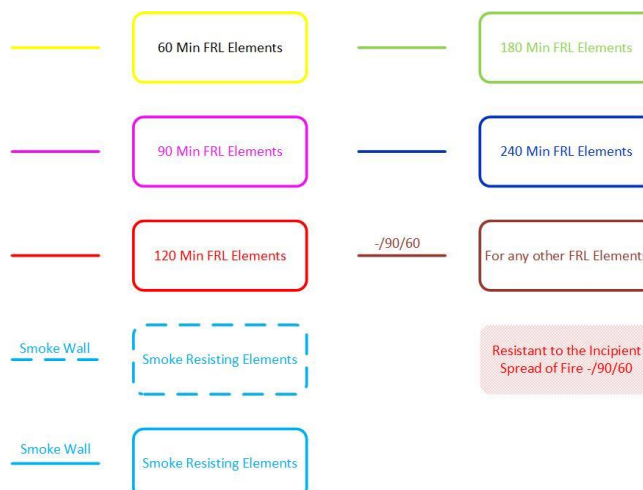


Figure 9 Colour Code of fire-resistant building elements/construction

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Figure 10 below provides an example plan of how this should be shown on a drawing.

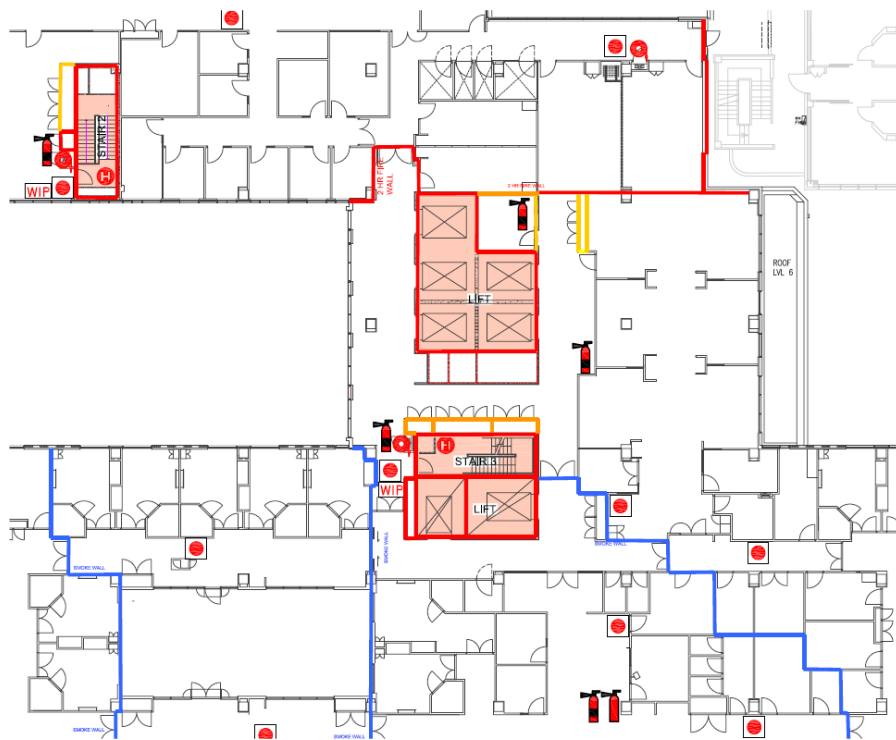


Figure 10 Example plan indicating location and FRL of fire-resistant building elements

Protection Method Registers (Baseline Data)

Due to the responsibilities detailed in Section 8.0 below, it is very important that the owner, facility manager and other building trades can easily and readily identify the location and type of fire-resisting building elements and the protection methods used to protect openings in those elements.

This documentation is best detailed and recorded in floor plans, as shown in Figure 10 above, and within 'as installed' system registers. These registers should detail the location, FRL, opening type, protection method used, test report number, etc.

See Appendix B of AS 4072.1 for an example of registering "as installed" protection methods for openings made by service penetrations. This type of register can be modified for other types of fire-resisting protection methods, such as fire doors, fire dampers and the like.

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Without registering each opening, identifying the protection method used and noting the FRL achieved, it is difficult to verify the evidence of suitability of the installation and extremely difficult to identify installed systems in future routine service inspections.

FPA Australia recommends registration of each opening and associated protection method in the form of a register.

8.0 Who is responsible for ensuring fire-resisting construction remains compliant?

Building owners are responsible for ensuring that their existing buildings and their buildings under construction meet and continue to meet the requirements of all relevant building legislation. For buildings built today, this includes meeting the requirements of the BCA and therefore, the Deemed-to-Satisfy (DTS) Provisions of Part C of the BCA (except where a Performance Solution is used).

Post occupancy approval, building owners or—in some jurisdictions (such as Queensland)—building occupiers are responsible for ensuring that the fire safety measures in their building continue to operate and perform to a level no less than that to which the measure was originally designed, installed and approved. How this is achieved and reported on varies greatly between jurisdictions*. However, most jurisdictions require some form of annual report confirming this.

*See the state and territory appendices in the Good Practice Guide (GPG-03) “Adoption and use of AS 1851-2012” (available at www.fpa.com.au) for more information on each jurisdiction’s maintenance requirements

Furthermore, most states and territories have legislation that permits the local council, fire brigade or both to enter a building to inspect that the fire safety measures in the building are suitable and continue to operate and perform as originally required. If the fire safety measures for the building are not operative, if the measures no longer perform as required, or if some other fire hazard exists, then the council or fire brigade can issue an order requiring the owner (or occupier, depending on the jurisdiction) to install, restore or upgrade the fire safety measures in the building.

Therefore, for ongoing occupation, fire safety measures (including fire-resisting building elements) must be routinely serviced.

Note: Building owners may engage an agent (a building manager, facility manager or other individual or company) to assist them to meet their obligations to ensure fire safety measures are compliantly installed and routinely serviced.

However, it is important to note that engaging an agent does not transfer responsibility from the building owner to their agent. The building owner is still responsible for meeting their legislative obligations, the agent simply assists them to do so.

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8.1 What a building owner (or occupier) must do

Building owners (or occupiers, in some jurisdiction) need to ensure that fire-resisting building elements remain compliant. Therefore, they need to ensure that any openings made for service penetrations in these elements are suitably protected. To do this, the building owner should:

- Engage competent installation contractors to perform the works.
- Ensure protection of openings created by service penetrations in fire-resisting building elements is included in the contracts with companies performing service works (electrical, plumbing, ventilation and air-conditioning, etc.).
- Contract a specialist passive fire protection contractor to work with the trade services contractors to ensure that all openings made for service penetrations made in fire-resisting building elements are compliantly sealed.
- Engage a competent routine service contractor to routinely service protection methods for openings made for service penetrations to ensure they continue to remain fit for purpose.

Note: While the above refers to the protection of openings made for service penetrations in fire-resisting building elements the same principles apply for the engaging someone to install the fire-resisting building elements in the first place or for other protection methods for opening in fire-resisting building elements (e.g. fire doors, fire shutters, etc.).

Note: The question of “What is a competent contractor?” varies between jurisdictions but almost all jurisdictions require licensing or registration of companies and individuals for most services (electrical, plumbing, etc.).

In addition, some jurisdictions have specific licenses for the installation, certification or inspection and testing of passive fire protection.

Where no registration or licence exists, we would recommend that building owners (or occupiers) seek confirmation of the contractor’s qualifications, experience and/or knowledge.

FPA Australia operates a voluntary accreditation scheme, the Fire Protection Accreditation Scheme (FPAS), which is one way to identify a competent qualified contractor for the inspection and testing (routine service) of passive fire protection. See <http://www.fpa.com.au/fpas/inspect-test.aspx>.

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9.0 Summary

Passive fire protection in the form of fire-resisting building elements for structural fire protection and/or compartmentation, and protection of openings in such fire-resisting building elements, is a necessary and required fire safety measure required for most Class 2 to 9 buildings. Fire-resisting building elements are required to maintain structural adequacy and stability and to avoid the spread of fire and therefore provide time for the evacuation of the building in the event of a fire. As such, ensuring the structural adequacy, integrity and insulation of these elements and compartments (including protection of openings through them) is essential to their fire-resisting performance.

This Good Practice Guide has provided readers with the information on passive fire protection:

- Why fire-resisting construction and fire compartmentation is important;
- The Building Code of Australia requirements for fire-resisting building elements and fire compartmentation;
- The requirements for evidence of suitability; and
- The necessary documentation for installation and routine service.

The information provided by this Good Practice Guide should assist the industry to ensure that fire-resisting building elements and any openings through them are appropriately protected and compliant.

10.0 References

- National Construction Code Series 2016 – Volume One, Building Code of Australia: Class 2 to Class 9 Buildings – Published by the Australian Building Codes Board, Canberra, Australia.
- National Construction Code Series 2016 – Guide to Volume One, Building Code of Australia: Class 2 to Class 9 Buildings – Published by the Australian Building Codes Board, Canberra, Australia.
- AS 1530.4-2014, *Methods for fire tests on building materials, components and structures - Fire-resistance test of elements of construction* – Published by Standards Australia International Ltd, Sydney.
- AS 4072.1-2005, *Components for the protection of openings in fire-resistant separating elements: Service penetrations and control joints* – Published by Standards Australia International Ltd, Sydney.

Fire Resistance

Leading and supporting a professional industry to minimise the impact of fire on life, property and the environment, for a safer community.

11.0 Disclaimer

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