Building in Bushfire Prone Areas

A 2024 Update

siniat

INTRODUCTION

Australia's susceptibility to bushfires frequently coexists with the natural beauty of country living. Sites with direct access to nature are frequently entwined with circumstances that elevate their vulnerability to bushfires, calling for detailed attention to bushfire-resilient design.

Bushfires have the potential to seriously damage infrastructure and property, and can result in fatalities. There are other factors, besides the fire, that pose a threat. Other impacts from bushfires include the effects of radiant heat and direct flame contact, fire embers that can spread significant distances from the location of the bushfire, and toxic fumes and heavy smoke.

Better planning and mitigation against the threat of bushfires is a complex and urgent issue particularly in Australia due to the growing density and sprawl of the built environment and the beginning of longer lasting and more intense fire seasons.

Although a building's survival from a fire in extreme conditions can never be guaranteed, there is a range of design measures that will increase its chances. Below, we survey the current landscape of bushfire design and the relevant building codes, standards and regulations.

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FIRE RESISTANCE STARTS WITH DESIGN

Fire-resistant strategies must be implemented even before the design stage to give a building a fighting chance of surviving a bushfire. Bushfires are a complex phenomenon, so it is important to assess the potential intensity of the fire and how the landscape will contribute to the bushfire risk.

Bushfire protection relies heavily on a robust planning system designed to reduce, not eliminate, the threat of bushfires. Understanding the site's limitations, site access, optimal building placement, low-risk landscaping options, ease of maintenance, local emergency management protocols, active defense options, accessways for evacuation, and on-site refuge options are the main factors to consider during the site planning stage. A water supply to the building should be considered for both active and passive defence.

A variety of coordinated measures is needed to create more bushfire-resilient buildings. The Australian Institute of Architects provides useful guidance on form, structural and material considerations that will help during design planning.[1] The design of the structure and materials will affect the building's protective capability during a bushfire. Some of the key strategies include:

- the use of fire-resistant materials;
- minimising gaps and penetrations through which flammable debris and embers can enter;
- preventing the spread of fire through cavity spaces; and
- the use of BAL-rated windows and doors.

Protection of water supplies and other services and the provision of easy access and egress options to ensure the efficient use of resources and safe evacuation routes are essential in ensuring building and occupant survival.

The Queensland Government published the Bushfire Resilient Building Guidance for Queensland Homes, which further outlines bushfire-resilient design principles. The key aspects of bushfire-resilient design include designs and materials that are robust (not easily damaged or compromised), design redundancy (ensuring that the building is not reliant on the effective performance of a single element), cost-effective and practical solutions, and solutions that work together to provide optimal bushfire protection.

Various building codes, regulations and standards specify the requirements for designing and building for bushfires. The main source of fire-resistant design is AS 3959 "Construction of building in bushfire-prone areas", which is referenced in Vols. 1 and 2 of the National Construction Code (NCC). This Standard was first published in 2009 and a revised version was released in 2018.

Compliance with AS 3959 is compulsory and sets the minimum controls for ensuring dwellings are resistant to bushfire.

PASSIVE HOUSE DESIGN

Bushfire-resilient design is linked with other modern design trends, particularly the movement towards energy-efficient Passive House design. The Bushfire Resilient Building Guidance for Queensland Homes explains why buildings built to high bushfire-resilient standards are also energy efficient:

"By necessity, a bushfire resilient home has fewer gaps and openings and better insulating properties, resulting in a home that requires less energy to heat and cool. Bushfire resilient homes also tend to be better built, meaning lower maintenance costs compared to traditional buildings. These economic and environmental benefits are magnified when considering future predicted climate changes."[2]

Passive House concepts were first developed in Germany in the 1990s and are currently being adopted all over the world. Australia is seeing a rise in the popularity of Passive House design, driven by its emphasis on energy efficiency and sustainability. This coincides with increasingly stringent energy efficiency standards across the country and other initiatives aimed at reducing the carbon footprint of the built environment.

Passive House design is a "fabric-first" approach predicated on adopting a few fundamental design principles that facilitate the construction of energy-efficient buildings with healthy, dry interior spaces that require that need minimal heating or cooling. The main characteristics of Passive design buildings are as follows:[3]

- airtightness;
- appropriate levels of thermal insulation;
- mechanical ventilation with heat recovery;
- high-performance windows and glazing;
- minimising thermal bridging in the building envelope;
- maximising use of shading and sunlight; and
- appropriate levels of thermal mass.

Many of the design strategies employed in Passive House design can also help make a building more resilient to bushfires. For example, the use of triple-glazed windows; an airtight building that also protects against smoke exposure; and the use of robust, fire-resistant cladding, decks and fences.

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CURRENT REGULATORY LANDSCAPE

The NCC includes bushfire requirements for different building classes. Part G5 Construction in bushfire-prone areas sets out the requirements for construction in designated bushfire prone areas.

In the 2022 update of the NCC, additional bushfire requirements were added for certain Class 9 buildings in bushfire-prone areas, that is, Class 9a health care buildings; Class 9b early childhood centers; primary schools or secondary schools; and Class 9c residential aged care buildings. For more information, refer to Clause G5P2 in the NCC 2022.

As noted above, AS 3959:2018 is the main source of bushfire design requirements, but a range of other Australian standards is also relevant. The current standards related to bushfire construction are:

- AS 3959:2018 "Construction of buildings in bushfire-prone areas";
- AS 5414:2012 "Bushfire water spray systems";
- Australian Building Codes Board's "Private Bushfire Shelters Performance Standard 2014"; and
- National Association of Steel-framed Housing's "NASH Standard; Steel Framed Construction in Bushfire Areas 2021".

Standards Australia is working on a number of significant projects to educate Australians about bushfire safety. For example, a 2024 handbook is currently being prepared with a focus on home maintenance in bushfire-prone regions and a review of general construction requirements for buildings in bushfire areas.

Urban and regional planning controls, land-use planning, town planning and other building and planning regulations may be in force in different parts of Australia. Planning control schemes can cover bushfire planning and construction requirements, in addition to other types of land use and development, including siting new buildings, constructing roads, subdividing land and more.

BUSHFIRE BASICS: AS 3959

Bushfire Attack Level

AS 3959 divides bushfire-prone areas into six Bushfire Attack Levels (BALs). BAL ratings are based on the building's potential exposure to ember attack, radiant heat and direct flame contact in the event of an uncontrolled bushfire. BAL is measured in increments of radiant heat expressed as kW/m^2. The six BALs are:

- BAL-LOW: very low risk
- BAL-12.5: low risk
- BAL-19: moderate risk
- BAL-29: high risk
- BAL-40: very high risk
- BAL-FZ: extreme risk (Flame Zone)

All new residential homes built in a bushfire prone area must undergo a BAL assessment as part of the application for a building permit. The Standard designates BAL-FZ as the most severe bushfire attack level, which focuses on protecting against radiant heat exceeding 40 kW/m2 and flame contact as well as ember attack.

Construction requirements

The BAL for a property is calculated according to AS 3959, which also specifies the building specifications for external walls, windows, floors, roofs, verandahs, and carports at each BAL rating. New homes constructed in bushfire-prone areas must meet the minimum construction requirements for BAL-12.5. Note that BALs may change over time due to environmental factors, such as when nearby areas become forested.

The Standard covers the following topics, which should be taken into account in relation to the building's assessed BAL rating:[4]

- subfloor supports, if not enclosed;
- floors, but slabs on ground have no requirements;
- walls, including up to 400mm from the ground;
- external glazed elements (doors and windows);
- roofs, including penetrations, guttering, gables, eaves, and fascias;
- verandahs, decks, steps and landings; and
- water and gas supplies.

The building's exterior must consist of non-combustible materials, or systems that contain combustible materials but have passed the relevant tests, or comply with other AS3959 requirements. Certain timber types can be used as cladding for up to BAL29, while brick veneer and double bring are compliant for all BAL ratings including FZ.

Description of bushfire attack levels from AS3959:2018

Bush Fire Attack level (BAL)	Heat flux exposure thresholds	Description of predicted bushfire attack and levels of exposure
BAL-LOW	See AS3959:2018 clause 2.2.3.2	There is insufficient risk to warrant specific construction requirements
BAL-12.5	≤12.5 kW/m^2	Ember Attack
BAL-19	>12.5 kW/m^2 ≤19 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL-29	>19 kW/m^2 ≤29 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL-40	>29 kW/m^2 ≤40 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of direct contact with flames
BAL-FZ	>40 kW/m^2	Direct exposure to flames from fire front in addition to heat flux and ember attack

Building to exceed the minimum bushfire requirements

Leading lightweight materials brand Siniat recommends always building to BAL-FZ requirements because any solution that satisfies the requirements of BAL-FZ will also work for a lower BAL, and lower BALs may increase over time if surrounding land is not kept cleared.

Weather Defence™ by Siniat is a rigid air barrier board most commonly used in ventilated facades or rainscreens to provide a pressure-equalised air cavity. Weather Defence is also used in bushfire applications, specifically in the roof system, where it provides BAL-FZ protection to residential builds in bushfire prone areas. Contact the Siniat Technical Team for more information about the bushfire roof application.

Weather Defence has a gypsum core and purple water resistant liner. It offers up to 12 months exposure to the elements, which means that projects can be closed in from the weather early.

In line with Passive House design concepts, Weather Defence installations can also improve the airtightness of the building, contribute to a building's energy efficiency and allow any glasswool insulation in the cavity to perform as intended by avoiding wind washing. The product is an excellent air control barrier that helps to regulate the indoor environment by restricting heat gain or loss via uncontrolled air movement through the facade.

Features and benefits:

- Vapour permeable Class 4 (recommended for use in Climate Zones 2 to 8)
- Flexible to accommodate contours of an architectural-designed building
- Easy to cut and install
- Compliant for facades requiring non-combustible construction
- Can be used in high wind zones of the facade
- Weather-resistant
- Improves the acoustic and thermal performance of the facade

REFERENCES

1 Australian Institute of Architects. “Site planning and design for bushfire.” AIA. https://www.architecture.com.au/wp-content/uploads/Acumen_Site-planning-and-design-for-bushfire_Australian-Institute-of-Architects.pdf (accessed 19 February 2024).

2 Queensland Government. “Bushfire Resilient Building Guidance for Queensland Homes.” Queensland Government. https://www.qra.qld.gov.au/sites/default/files/2020-12/0576_qra_bushfire_guideline_v10_pages_print.pdf (accessed 19 February 2024).

3 Australian Government. “Passive House.” YourHome. https://www.yourhome.gov.au/passive-design/passive-house (accessed 19 February 2024).

4 Australian Government. “Bushfire protection.” YourHome. https://www.yourhome.gov.au/live-adapt/bushfire-protection (accessed 19 February 2024).

All information provided correct as of April 2024