A guide to retrofitting certain existing Class 9 buildings for better protection from bushfire ember attack

INTRODUCTION

The Victorian Building Authority ('VBA') and the Country Fire Authority ('CFA') have jointly prepared this guide ('Guide') to assist those who wish to upgrade existing public buildings for the purpose of providing better protection from bushfire ember attack.

BACKGROUND

The Guide responds to a recommendation of the 2009 Victorian Bushfire Royal Commission ('VBRC'), which was established on 16 February 2009 to investigate the causes and responses to the bushfires that swept through parts of Victoria in late January and February 2009.

The VBRC delivered a Final Report on 31 July 2010. Recommendation 49.2 of the VBRC's final report was to:

… apply bushfire construction provisions to non-residential buildings that will be occupied by people who are particularly vulnerable to bushfire attack, such as schools, child care centres, hospitals and aged care facilities

In response to the recommendation, the Victorian Government made the *Building Amendment (Specific Use Bushfire Protected Buildings and Other Matters) Regulations 2016* ('Amended Regulations'). The amended regulations apply to the construction of new and significantly modified specific use bushfire protected buildings within designated bushfire prone areas, which must be designed and constructed with improved bushfire protection in compliance with Australian Standard AS 3959: 2009 – Construction of Buildings in Bushfire Prone Areas ('AS 3959') (see regulation 158 of the *Building Regulations 2018*).

The amended regulations, however, do not require the retrofitting of existing buildings that fall within the definition of "specific use bushfire protected buildings", which may be prone to bushfire ember attack.

SCOPE OF THIS GUIDE

This Guide provides information to assist with the voluntary retrofitting of existing public buildings, in order to improve their resistance to ignition from bushfire ember attack.

It does not provide information or guidance in relation to retrofitting existing public buildings to provide a level of protection from other sources of ignition, such as exposure to radiant heat and possible flame contact from a bushfire front.

A Bushfire Attack Level ('BAL') assessment will help you to determine the level of bushfire risk your building is likely to be subject to.

BUILDINGS THIS GUIDE APPLIES TO

This Guide applies to the following existing buildings:

- Health care buildings (e.g. hospitals, nursing homes) (Class 9a);
- Aged care buildings (Class 9c);
- School buildings; and
- Early childhood centres.

As mentioned above, in the Building Regulations, these buildings (in addition to some Class 4 and 10a buildings) are defined collectively as: "specific use bushfire protected buildings". For consistency with the Regulations, in this Guide, this term is adopted, but shortened to: "specific use buildings" to collectively describe the four types of building listed above.

WHY THESE BUILDINGS?

Specific use buildings are considered to have sensitive uses, because they are generally occupied by people who are particularly vulnerable during emergencies such as bushfire. This Guide provides various methods for retrofitting existing specific use buildings to reduce the likelihood of their ignition by embers during a bushfire.

APPLICATION OF THIS GUIDE

This Guide is provided on the basis that any person relying on it undertakes responsibility for assessing the relevance and application of its contents to their specific circumstances. Any person who is uncertain about the application of this Guide should seek professional advice.

It is important to understand that upgrading any building in accordance with this Guide will not guarantee that the building will withstand a bushfire event. Nor does it render a structure inherently suitable as a place of refuge during a bushfire.

For these reasons, the information contained within this Guide should not be relied upon as a life safety protection strategy, because the most appropriate life safety protection strategy is early evacuation. Accordingly, it is important that emergency management plans have multiple contingencies.

For example, in respect of schools:

- Early closure, early relocation/evacuation;
- Taking shelter in a building;
- Safe egress to an alternate place in circumstances where the sheltered building ignites.

It is also important that this Guide is read in conjunction with AS 3959 to appreciate and understand the various construction protection methods recommended below. Moreover, some of the construction methods within this Guide are enhancements to similar provisions in AS 3959.

For example:

- This Guide recommends enclosing sub-floors as a protection method to existing specific use buildings, whereas AS 3959 may not require such enclosure.

- This Guide recommends a maximum gap size of 2mm based on new scientific evidence, whereas AS 3959 allows 3mm.

Nevertheless, as this Guide is not mandatory, a building owner may elect to comply with AS 3959 instead.

The methods contained within this Guide are complementary to a holistic bushfire risk mitigation strategy, which may include the following elements:

- Vegetation management;
- Provision of access and egress;
- Fire-fighting water;
- Emergency management planning;
- Staff training, etc.;
- Additional strategies as identified in the CFA website.

IS RETROFITTING MANDATORY?

Retrofitting is not mandatory. This Guide has no basis in legislation and cannot be enforced. As a result, it places no legal obligation on any party to retrofit existing buildings. It is published for general information only and for use on a voluntary basis.

BUSHFIRE RISK

Bushfires kill. The only sure way to survive a bushfire is to be well away from the threat.

Even well-prepared buildings can be destroyed by bushfire. Survival of building occupants is of paramount importance, and a well prepared and practiced bushfire management plan will help to manage bushfire risks.

Information about the bushfire risks that may be experienced at locations in each bushfire attack level can be found in AS 3959 or *A guide to retrofit your home for better protection from a bushfire*, available on the VBA and CFA websites.

The VBA and CFA recommend that particular attention is paid to identifying and understanding the bushfire risk using professional advice prior to considering the application of protection methods in this Guide.

BUSHFIRE BEHAVIOUR

Bushfire behaviour is influenced by several key environmental factors, which are considered in the forecast of the Fire Danger Index and the adopted Fire Danger Rating. The extent of vegetation and location also influence bushfire behaviour.

FIRE DANGER INDEX

Every day during the fire season, the Bureau of Meteorology forecasts an outlook of the Fire Danger Index ('FDI') by considering elements of the predicted weather, including temperature, relative humidity, wind speed and dryness of vegetation.

FIRE DANGER RATING

Victoria has adopted the nationally agreed Fire Danger Ratings. These ratings recognise the significant increase in severe bushfire conditions over the past decade, as well as the heightened level of danger to the community, as experienced on Saturday, 7 February 2009. Further work is being undertaken at a national level to refine and improve the National Fire Danger Ratings System.

VEGETATION AND LOCATION

Vegetation and location significantly impact fire intensity. In addition to the FDI on the day of a fire, the type and arrangement of vegetation in proximity to a building will play a significant factor in determining the impact and effects of bushfire that are likely to be experienced. Professional advice may be required to understand the level of bushfire risk a particular building is exposed to, as this will relate to the type of vegetation and geometry of the landscape.

IMPACT MECHANISMS

Bushfires can impact on buildings via three key mechanisms:

- Ember attack
- Radiant heat from the fire front
- Direct flame contact from the fire front.

The FDI and proximity of a building to vegetation and the fire front will determine whether a building is subject to:

- all three mechanisms, or
- a limited combination of the three mechanisms, or
- an ember attack during a bushfire event.

Even where ember attack from a fire front is the only mechanism, a building may still have flame contact from local surface fuels that could be ignited by embers.

Understanding the type of bushfire behaviour that might be experienced at a site will provide an appreciation of the extent of site preparation and construction features that a building owner may wish to employ.

RETROFIT PROVISIONS RELATING TO EMBER ATTACK

Ember attack can occur over distances greater than 1km from the fire front, although the likelihood of associated building loss reduces significantly with an increased distance from the fire front. Any gaps, cracks or an area where embers are able to lodge can significantly increase the building's vulnerability to ignition.

RETROFIT CONSTRUCTION

The retrofit methods contained within this Guide specifically relate to improved protection of buildings from ember attack and are considered to represent a minimum level of bushfire resistance. Where there are multiple buildings on a site, consideration needs to be given to the potential impact of nearby buildings. Retrofitting a building that could be exposed to the radiant heat of another building likely to burn during a bushfire event is not appropriate.

See the more detailed discussion in 'Nearby Structures' on page 11 of this Guide.

Prior to carrying out any retrofitting work to an existing building, it is important that all relevant permits, such as a Building Permit and/or a Planning Permit, are obtained, if required. Therefore, advice should be sought from the relevant council or shire, and from a registered building surveyor, prior to any work taking place.

1. Flooring systems and sub-floor

As a minimum, carry out the following work:

- Remove combustible materials from the sub-floor space.
- Enclose elevated timber-framed sub-floors with non-combustible sheet materials, such as compressed fibre cement or metal sheets, or install metal mesh or perforated sheet screening with a maximum aperture of 2mm.

2. Walls and fascia

Ideally, replace or cover combustible wall cladding and fascia with a non-combustible material.

As a minimum, replace or cover external surfaces of walls that are less than 400mm above the ground or other horizontal or near-horizontal surfaces where embers can collect with a non-combustible material, such as metal or fibre cement sheet, and cover or seal all joints in the external surface material of walls to prevent gaps greater than 2mm.

3. Vents and weep holes

Seal sub-floor vents and weep holes with a metal mesh that has a maximum aperture of 2mm.

Seal other external wall openings greater than 2mm with silicone sealant.

Figure 1 – Weep hole protection

4. Roofs

Protection may be provided by sealing any gaps greater than 2mm in tiles or roofing metal at the fascia, wall line, valleys, hips and ridges – under corrugations or ribs of roof sheeting, or between tiles or other roof components with:

- metal mesh or perforated sheet with a maximum aperture of 2mm; or
- mineral wool; or
- silicone sealant; or
- a combination of the above.

Seal the roof and wall junction to fill gaps greater than 2mm by using eaves lining or sealing the top of the wall to the rafters at the line of the wall.

Fit ember guards over roof ventilation points (such as gable end and roof vents) with metal mesh or perforated sheet with a maximum aperture of 2mm.

Penetrations through roofs (including roof lights, roof ventilators, aerials, vent pipes and supports for solar connectors) should be sealed with a non-combustible material, such as mineral wool or silicone sealant, at the roof to prevent gaps greater than 2mm. If made of plastic, consider replacing with metal equivalents or fit with ember guards made from metal mesh or perforated sheet with a maximum aperture of 2mm.

Note: Properly sealing all gaps in a tiled roof is an onerous task. Consideration could be given to replacing a tiled roof with metal.

Figure 2 – Penetration seal

Openings in vented roof lights, roof ventilators or vent pipes should be fitted with ember guards made from metal mesh or perforated sheet with a maximum aperture of 2mm.

Figure 3 – Ember protect roof cowl

Figure 4 – Ember guard in vent

Figure 5 – Ember protection roof vents

- All overhead glazing should consist of laminated or toughened safety glass with appropriate thickness.
- Replace glazed elements in roof lights and skylights with laminated or toughened glass; or ember protect the entire fitting with metal mesh or perforated sheet with a maximum aperture of 2mm.
- Evaporative cooling units should be fitted with non-combustible covers with metal mesh or perforated sheet with a maximum aperture of 2mm.
- Contact the manufacturer regarding ember protection and properly sized mesh covers.

5. Eaves, gutters and downpipes

Protect penetrations through eaves by using the same methods as outlined for roof penetrations. Any penetrations through eaves with openings greater than 2mm should be sealed with a non-combustible material, such as mineral wool or silicone sealant, or fitted with ember guards made from metal mesh or perforated sheet with a maximum aperture of 2mm.

Box gutters must be non-combustible and flashed at the junction of the roof with non-combustible material. Where installed, ensure that gutter and valley leaf guards are non-combustible. Gables should be protected as per the requirements for walls.

All above-ground and exposed water/gas supply pipes should be metal.

6. Windows (including skylights)

Protect window assemblies with external metal screens or bushfire shutters.

If window assemblies/frames are less than 400mm above the ground or other horizontal or near-horizontal surfaces where embers can collect, replace with frames made of:

- metal or metal-reinforced PVC-U; or
- bushfire-resisting timber, as specified in AS 3959 Appendix F; or
- a combination of the above.

External window hardware should be metal.

Figure 6 – Window with mesh screen protection

Where windows are not protected with external screens or bushfire shutters:

- Glazing less than 400mm above the ground, decks, carport roofs, awnings and similar horizontal elements should consist of laminated or toughened safety glass with appropriate thickness for the glazing panel size; and
- External screens should be provided to openable portions of windows.

Where fitted, check that any existing bushfire shutters are made from:

- non-combustible materials; or
- bushfire-resisting timber, as specified in AS 3959 Appendix F; or
- a combination of the above.

Where fitted, screens for windows and doors should have metal mesh or perforated metal sheet with a maximum aperture of 2mm. Gaps around the perimeter of the screen to the building should not exceed 2mm.

The frame supporting the mesh or perforated sheet should be:

- metal; or
- bushfire-resisting timber, as specified in AS 3959 Appendix F; or
- a combination of the above.

Figure 7 – Doors with mesh screen protection

7. Main entry to foyers

Glazing to the entry foyers should consist of toughened or laminated glass with appropriate thickness, and should also include smoke seals around openable doors and windows.

Create a non-combustible apron at least 3m wide outside the entry foyer, with low or non-combustible features beyond that point.

Protect window assemblies with external metal screens.

8. Secondary external doors

Slide-hung doors

Unless external doors and frames are:

- non-combustible; or
- a solid timber door with a minimum thickness of 35mm; *and*
- any glazing is laminated or toughened glass;

then protect external doors with:

- external metal screens; or
- bushfire shutters (see windows); *and*
- smoke seals fitted to the entire perimeter of doors.

Figure 8 – Door with kickplate

All door hardware should be metal. Any part of a door that is less than 400mm above the ground or other horizontal or near-horizontal surfaces where embers can collect should be fitted with a metal kick plate.

9. Unenclosed external structures connected to the building

- External structures should be constructed in accordance with the general building provisions for ember attack listed above.
- Ensure the space between decking timbers is less than 2mm.
- Materials used to enclose sub-floor spaces should be provided in accordance with the recommendations for flooring systems.

Ideally, decking, stair treads and risers, and trafficable surfaces of ramps and landings connected to a building should be replaced with non-combustible material or bushfire-resisting timber, as specified in AS 3959 Appendix F.

If glazed elements (windows, doors etc.) are located less than 400mm vertically above decking, stair treads or trafficable surfaces of ramps and landings, then the surface of the deck, tread, ramp or landing within 300mm horizontally from the glazed element should be made from:

- non-combustible materials; or
- bushfire-resisting timber, as specified in AS 3959 Appendix F; or
- covered with a non-combustible material, such as sheet metal or compressed fibre cement sheet.

10. Unenclosed external structures connected to the building

Loading bays constructed of non-combustible materials, such as concrete and steel, can be protected as an ember entry point by:

- fitting the bases of roller doors with silicone compression seals; and
- fitting the sides and heads of roller doors with brush ember/smoke seals; and
- storing waste or combustible materials outside loading bay areas. Any deliveries within the loading bay must occur in a timely manner.

Where a loading bay is constructed of combustible materials or also serves as a storage facility, seek expert advice regarding fire separation of the loading bay from the remainder of the building, or the possible use of sprinklers to mitigate potential ignition of materials by embers. A registered fire safety engineer should be consulted.

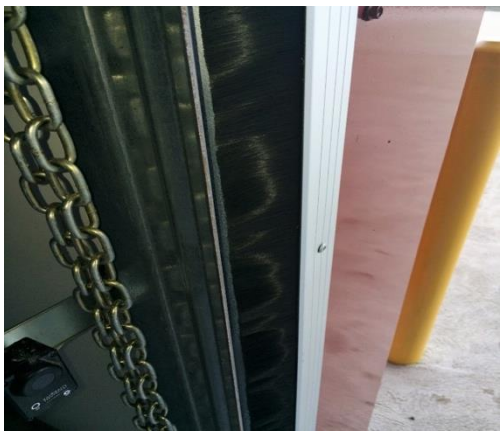

Figure 9 – Roller door brush seal

Figure 10 – Seal at base of roller door

11. Immediate building surrounds

Create a low-threat environment around the building by removing or minimising combustible material, including vegetation within 10m of the building. Review the immediate surrounds for plastic equipment, wood piles, timber retaining walls, gas cylinders not connected to the building etc. Consider creating a non-combustible concrete apron at least 1–2m wide around the entire perimeter of the building. Ensure a low combustible environment beyond that point to a distance of 6m from the building. Judicious planting may be used with appropriate plants. The CFA publication, *Landscaping for Bushfire*, provides appropriate and useful guidance about the placement and choice of plants to avoid subjecting vulnerable parts of a building, such as windows and eaves, to radiant heat shock or localised flame contact. Choosing plants with low flammability and locating them correctly will help reduce bushfire risk.

12. Nearby structures

In some cases, a decision may be made to retrofit one of several buildings on a site. A significant structure that is located near a retrofitted building can present a higher ignition threat to the building than an ember attack. Radiant heat and/or flames from a nearby burning structure may be enough to ignite a building, even if it is retrofitted for ember attack. If there are other buildings located near the proposed retrofitted option, it is recommended that a registered fire safety engineer is engaged to analyse the risks and provide appropriate advice.

13. Mechanical ventilation equipment

Mechanical ventilation equipment and plant room ventilation can provide ember entry points into a building via the air intake or exhaust vents. Air intake/exhaust vents should be fitted with non-combustible covers with metal mesh or perforated sheet with a maximum aperture of 2mm. These may have to be oversized to accommodate the air volumes required to be entering into or exhausted from the system. Advice from a mechanical engineer should be obtained.

Figure 11 – Ember guard roof exhaust system

Figure 12 – Vented plant room with ember guard

14. Rubbish and recycling bins

Mobile combustible fuel loads, such as rubbish skips and recycling bins, should be kept at least 6m away from buildings or stored in a fully ember-protected enclosure.

15. Gas and fuel storage

LPG or medical gas cylinders and tanks should be housed, so that they will not present a risk to the building and/or its occupants in a bushfire event. Specialist enclosures/containers are available for the storage of gasses and fuels, such as petrol or diesel. Specialist advice for the particular gas or fuel should be obtained.

16. Maintenance

A maintenance program should be put in place to ensure the ongoing integrity of the existing building to provide resistance to ember attack. Any other work designed to achieve the initial risk mitigation should also be reviewed on an annual basis. This would include any vegetation management initially provided, review of housekeeping procedures, and a thorough inspection of the building fabric to ensure that all ember attack prevention measures originally implemented remain in order, and that no new weaknesses in the building fabric have appeared.

SUMMARY

The buildings covered by this Guide are considered to have sensitive uses, because they are generally occupied by people who are particularly vulnerable to bushfire attack. These uses include health care, aged care, schools and early childhood centres.

Whilst there are regulations in place in Victoria that require all new specific use buildings within designated bushfire-prone areas to be designed and constructed with improved bushfire protection in compliance with AS 3959, the regulations do not require existing specific use buildings, which may be prone to bushfire ember attack, to implement bushfire protection construction measures.

This Guide assists those who seek to voluntarily upgrade an existing specific use building to provide better protection from bushfire ember attack. Whilst this Guide is not mandatory, it does provide important information and guidance on various methods to better protect existing specific use buildings from ember attack.