Australian Institute of Architects | October 2020

BUILDING BACK BETTER – STEEL BUILDING MATERIALS & BUSHFIRE DESIGN

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Key Headlines

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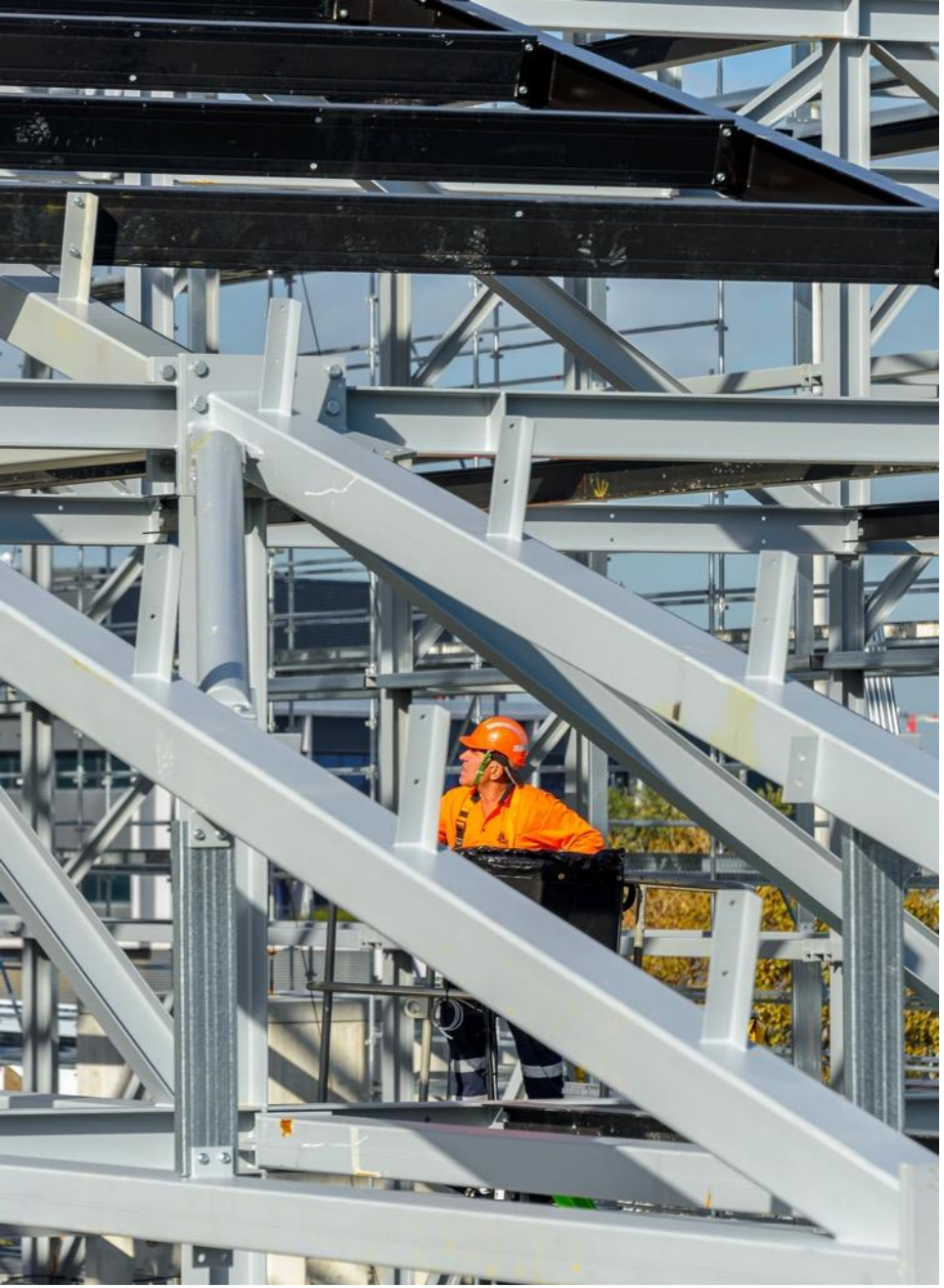
- We cannot keep doing the same things & expect a different result:
  - Big opportunity - well designed & engineered solutions
- Use of non-combustible materials that are “fit for purpose” – such as steel – is critical
- Strong need for complete building barriers to ember attack – super important
- Hi strength, durable materials suitable for changing climatic conditions
- Composite non-combustible materials working together with steel provides great options
- Need full lifecycle view – steel can be used very effectively in a sustainable way
- Added value - building fire resistant homes deliver:
  - Insulation for heat & cold
  - Strength to withstand all weather conditions – long term solutions

TOPICS OUTLINE

- Introduction to ASI
- The Climate We're In – Bushfire Events
- What Generates Bushfire Risk
- Briefly, Building Codes and Regulations
- Bushfire Building Council of Australia
- Fire Resistance for Buildings
- Light Gauge Steel Solutions
- NASH Bushfire Standard
- Some General Principles
- Summary



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INTRODUCTION TO **ASI**

- Australia's peak steel industry association
- Serves through representation, technical, quality & marketing leadership:
  - Govt advocacy
  - Nat Structural Steelwork Compliance Scheme / AS/NZS 5131
  - Environmental Sustainability Charter
  - Education & Learning Programs
- Promotes critical role steel plays across the cons. supply chain
- Facilitates industry competitiveness

INTRODUCTION TO **ASI**

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ASI MEMBERSHIP REPRESENTATION				
Product supply chain:	Steel mills	Distributors	Roll formers	Fabricators
Services:	Galvanizing	Painting	Support services	Detailers
Professional:	Builders	Engineers / Architects	Specifiers	Education

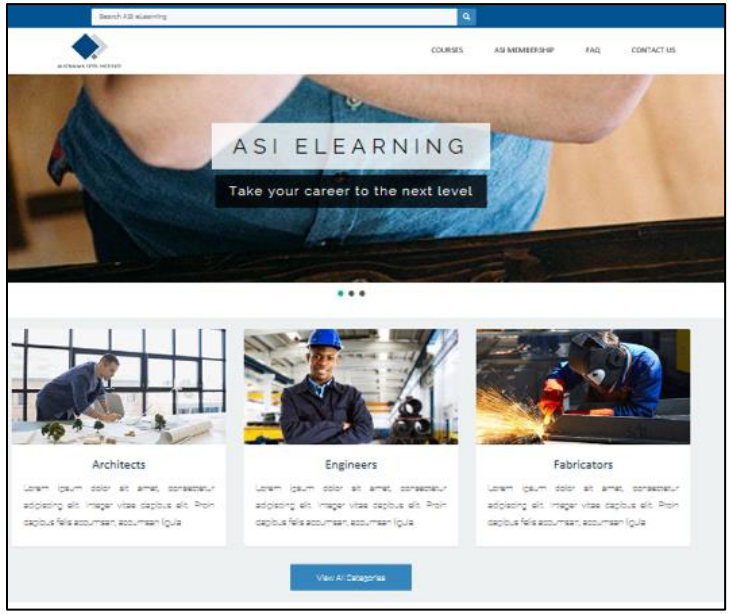



INTRODUCTION TO **ASI**

ASI Learning Resources & Services

- Face to face seminars
- eLearning
- Digital Library Books
- Technical Notes
- CPD Points

ASI eLearning: https://www.steel.org.au/resources/eLearning/
ASI bookshop: https://www.steel.org.au/resources/bookshop/
ASI eLibrary: https://www.steel.org.au/resources/elibrary/



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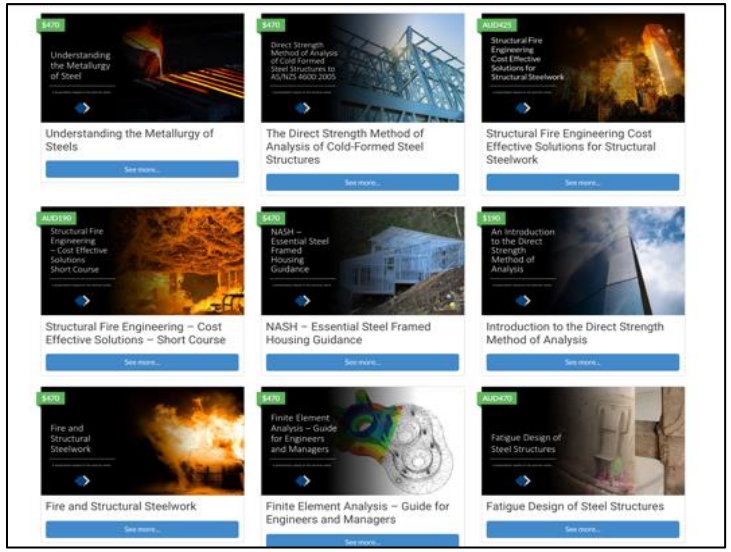

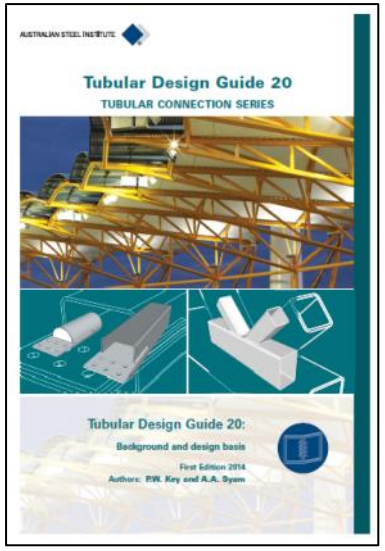

TEMPERATURES **RISING…**

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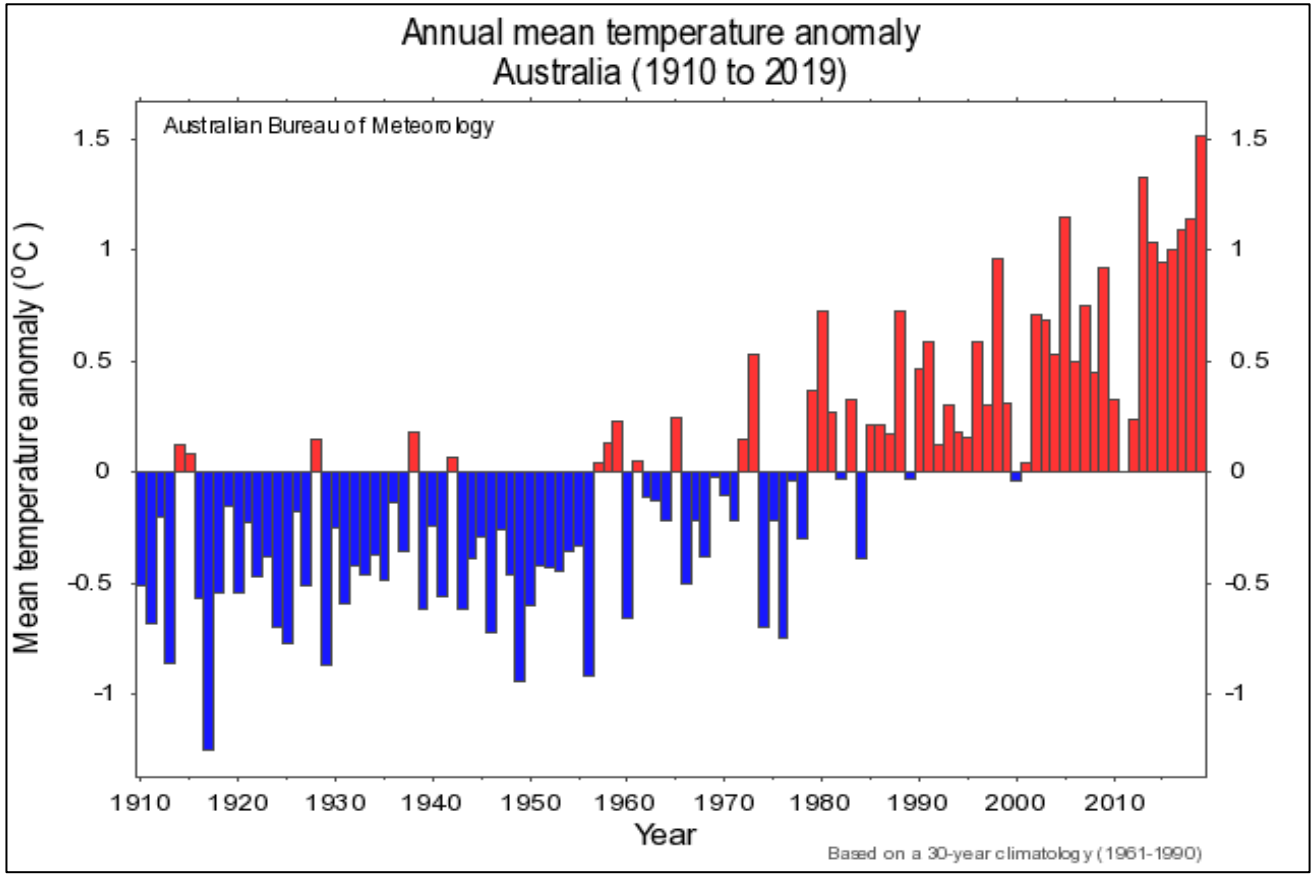

MAJOR BUSHFIRES **IN AUSTRALIA**

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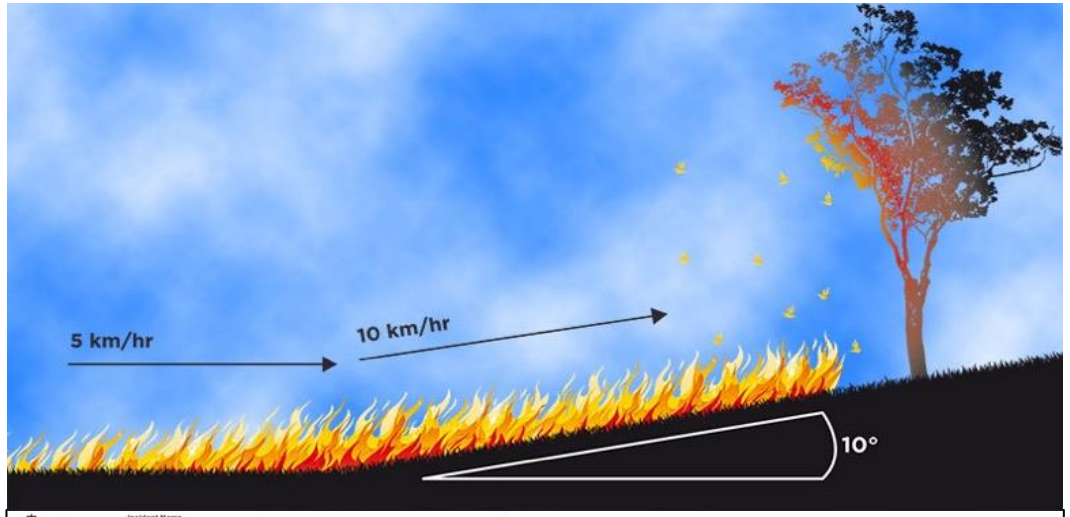
Year	State	Lives Lost	Houses Destroyed	Hectares Burnt Out
1926	VIC	60	1,000	390,000
1939 (Black Friday)	VIC	71	3,700	2,000,000
1944	VIC	20	500	1,000,000
1962	VIC	32	450	(not reported)
1967 (Black Tuesday)	TAS	62	1293	264,000
1983 (Ash Wednesday)	VIC & SA	75	2,400	418,000
2009 (Black Saturday)	VIC	173	2,029	450,000
2019-2020	ALL	34	2,600	18,000,000

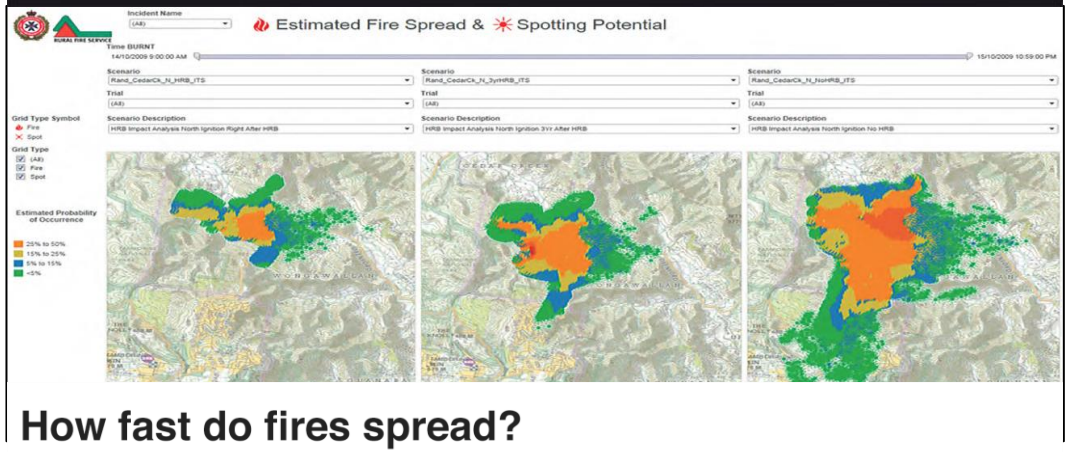
Source: https://en.wikipedia.org/wiki/Bushfires_in_Australia

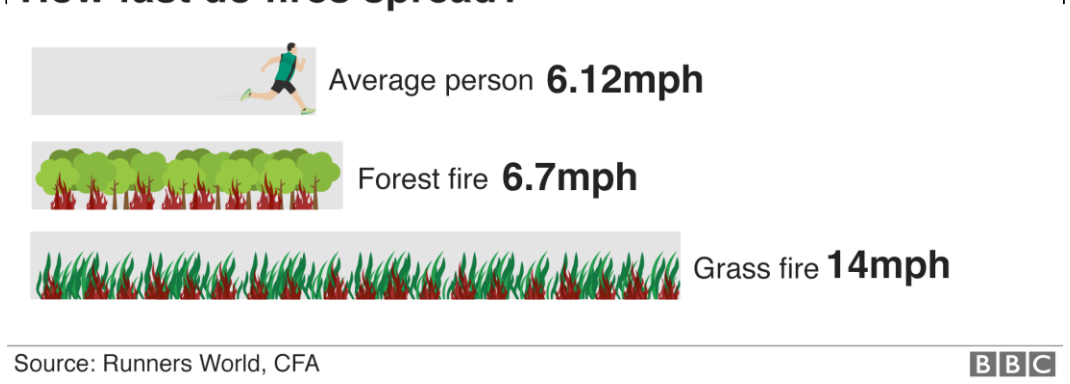
BUSHFIRE RISK **FACTORS**

- Terrain: fires run faster up hills
- Fuel: vegetation and building **materials**
- Hot, dry weather conditions
- Wind speed and direction
- Sudden change in wind direction

Image 1: https://www.cfa.vic.gov.au/plan-prepare/how-fire-behaves
Image 2: Bushfire Prevention & Preparedness, Queensland Government
Image 3: BBC, Runners World, CFA





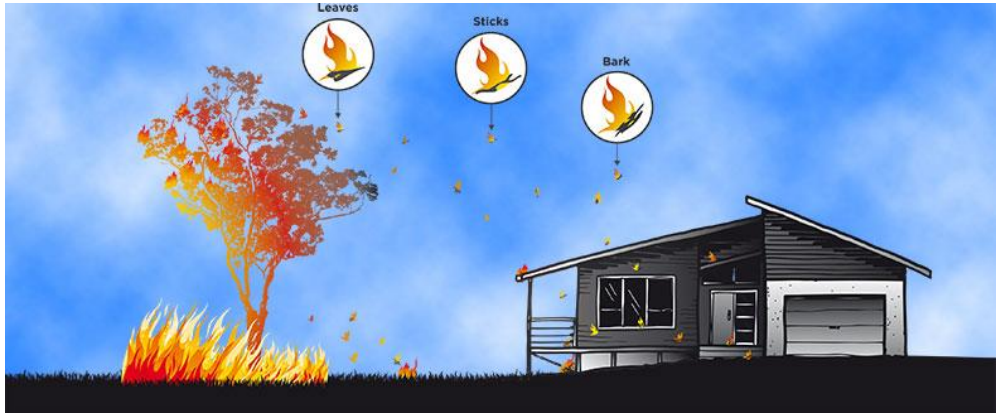


HOW BUILDINGS **BURN**

Ember Attack: major cause (90%) of building damage during bushfires is when embers enter the building through unprotected openings. Embers can start small fires well before the main fire front arrives, or many hours after.

Direct Flame Contact: Direct flame contact occurs when vegetation or other flammable materials close to a building ignite, causing flames to come in direct contact with the outside of the building.

Images: https://www.cfs.sa.gov.au



BUILDING CODES & **REGULATIONS**

NCC Vol 2, Class 1 and 10a Buildings

NCC governed by Aust Building Codes Board (ABCB) – mandates ensuring safety of building occupant lives via:

1. Performance Solution
2. Deemed to Satisfy Solution (DTS) o

Two DTS methods of complying with the NCC

- NASH Standard
- AS3959

BUILDING CODES & **REGULATIONS**

The DTS methods are legally 'deemed' to satisfy', however:

- The performance statement – **opens the opportunity for innovation for architects – using fire engineers and building certifiers**

Performance Solutions Reference: NCC Bushfire Verification Handbook, ABCB, 2019

- Design & approval of performance solutions
- Design for ember & radiant heat attack
- Assessing NCC performance approvals:
  - GV5 and V2.7.2 verification methods
  - DTS, eg AS 3959

STATE **GOVERNMENTS**

- Designated bushfire prone areas typically defined through State Building legislation

- Designated bushfire prone areas are required to meet the mandatory bushfire provisions in NCC and BCA, and in AS 3959–2018 Construction of buildings in bushfire prone areas :

    - The **NCC performance requirement: ‘a building that is constructed in a ‘designated bushfire prone area’, must to the degree necessary, be designed and constructed to reduce the risk of ignition from a bushfire, appropriate to the potential for ignition caused by burning embers, radiant heat or flame generated by bushfire**

    - **AS 3959–2018** contains provisions which include requirements for **burning debris and ember protection**, controls on the combustibility of exterior material, and the protection of openings, such as windows and doors.

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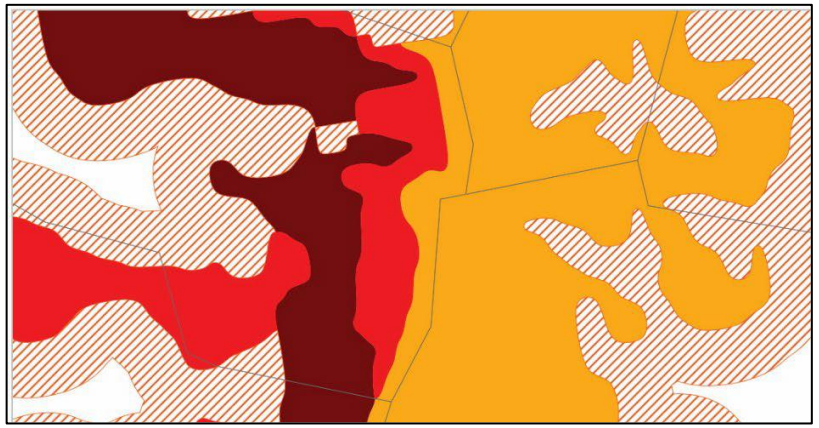

Images: https://www.cfs.sa.gov.au

BUSHFIRE BUILDING **COUNCIL OF AUSTRALIA**

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https://www.rfs.nsw.gov.au/plan-and-prepare/prepare-your-property

A property that achieves 5 Star Bushfire Resilience has reduced the likelihood of house ignition to less than 10%.

The likelihood of ignition applies to fire weather on days up to Extreme (less than FDI 100).

The measures required to achieve a 5 Star Rating depend on the site risk.

https://www.bbca.org.au/

BUSHFIRE BUILDING COUNCIL OF AUSTRALIA

Learnings from more recent disasters – Kate Cotter, CEO

- BAL Ratings measure potential flame radiation – but ember attack is the major problem
- Use of non-combustible building materials is critical
- Storage items in and around the house
- Pay attention to embers:
  - Penetrating the house: secure all external gaps and heat penetration
  - Igniting items close to the house
  - Travel distance and post fire
  - Evidence presented at the Royal Commission: ensure the house is well sealed

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Bellbird Retreat **by Steendyk Architecture**

BUSHFIRE BUILDING **COUNCIL OF AUSTRALIA**

Learnings from more recent disasters (continued) – Kate Cotter, CEO

For Architects:

- Design for bush fire: beautiful design but robust and resilient
- Combustibility of cladding
- Materials (non - oil based / toxicity) and building systems
- Clear view of threat
- Landscaping, planned, integrated
- Design provides best chance of survival – building and exits
- Driving innovation / affordability & equity
- House to house risk
- Learn from scientists and fire engineers

Karri Fire House **Denmark WA by Ian Weir and Kylie Feher**

BUSHFIRE BUILDING
COUNCIL OF AUSTRALIA

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Murrindindi Vic – Black Saturday

Murrindindi Vic – Black Saturday

BUSHFIRE BUILDING
COUNCIL OF AUSTRALIA

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Simpson Lee House **Blue Mountains by Glenn Murcutt (1986)**

Montecito Residence**, California by Olsen Kundig (Tom Kundig - 2007)**

FIRE RESISTANCE **FOR BUILDINGS**

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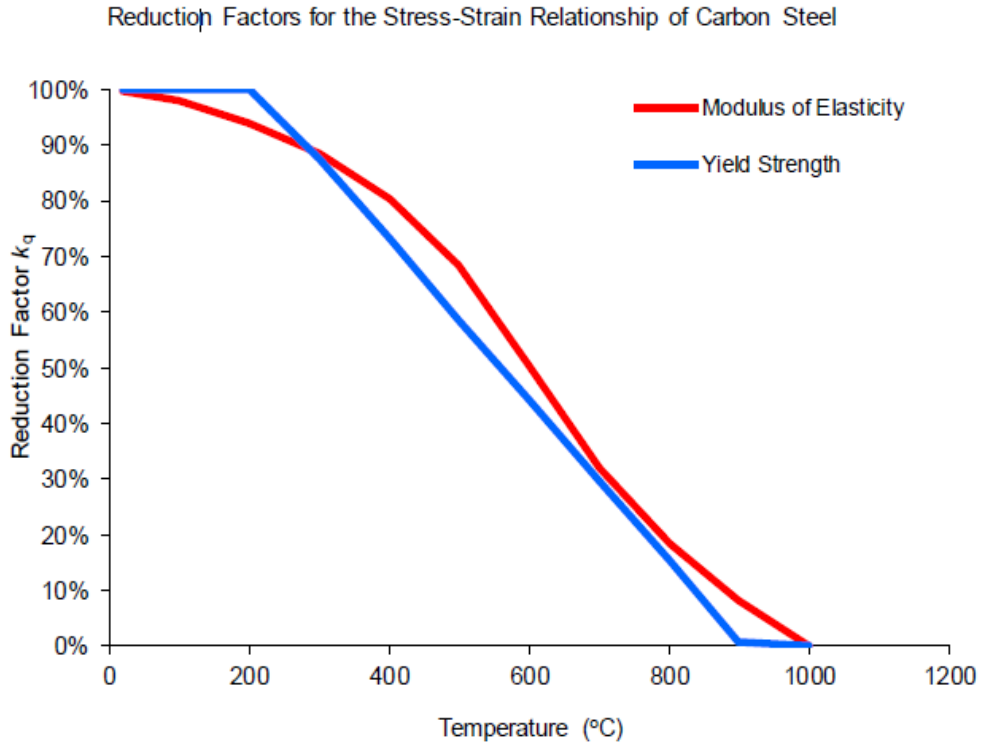
Building for Fire Resistance – key considerations:

- Safety & robustness
- Prevent combustion
- Design & aesthetics
- Critical - Built-in (passive) bushfire-resistant design prevents peak temperature
    - Limit spread
    - Combined effect of non-combustible mats.



Performance Solution

- BCA Performance Requirements
- Maintain structural stability (CP1)
- Resist spread of fire (CP2)

Ref: Holmes Fire, Dr Linus Lim; ASI presentation series; July 2017
https://learn.steel.org.au/courses/fire-engineered-design/

FIRE RESISTANCE **FOR BUILDINGS**

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Designing the structure for fire resistance….
provides time for occupants

Non-combustible materials both outside and inside….

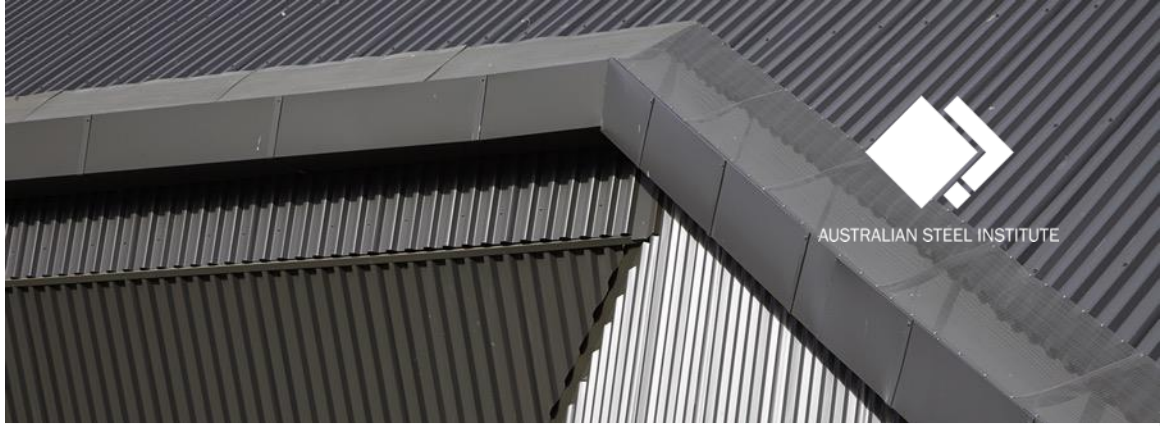
Ref: Holmes Fire, Dr Linus Lim; ASI presentation series; July 2017

LIGHT GAUGE
STEEL SOLUTIONS

Light gauge steel may be used for:

- Cladding (pre-coated profiled metal sheeting)
- Cladding support structure (purlins, girts)
- Composite steel-concrete (concrete suspended slabs)
- Internal partitioning
- Main structural support (mid rise construction)
- Structural steel can be integrated in design with light gauge steel

See: https://www.steel.org.au/focus-areas/cold-formed-light-gauge-steel//



Light gauge steel solutions – cold formed steel Standard

Australian Steel Institute

AS/NZS 4600 – Cold-formed steel structures, Sect 9

- Given that thin-walled cold-formed steel structural members have a high exposed-surface-area-to-mass ratio, the **design methodology is based on members being protected by fire-resistant barriers when they are required to have an FRL**.

https://www.steel.org.au/focus-areas/steel-and-fire/design-using-structural-fire-standards/

Image: BlueScope Truecore Frame, Ausmar Homes: https://truecore.com.au/hall-of-frame

LIGHT GAUGE
STEEL SOLUTIONS

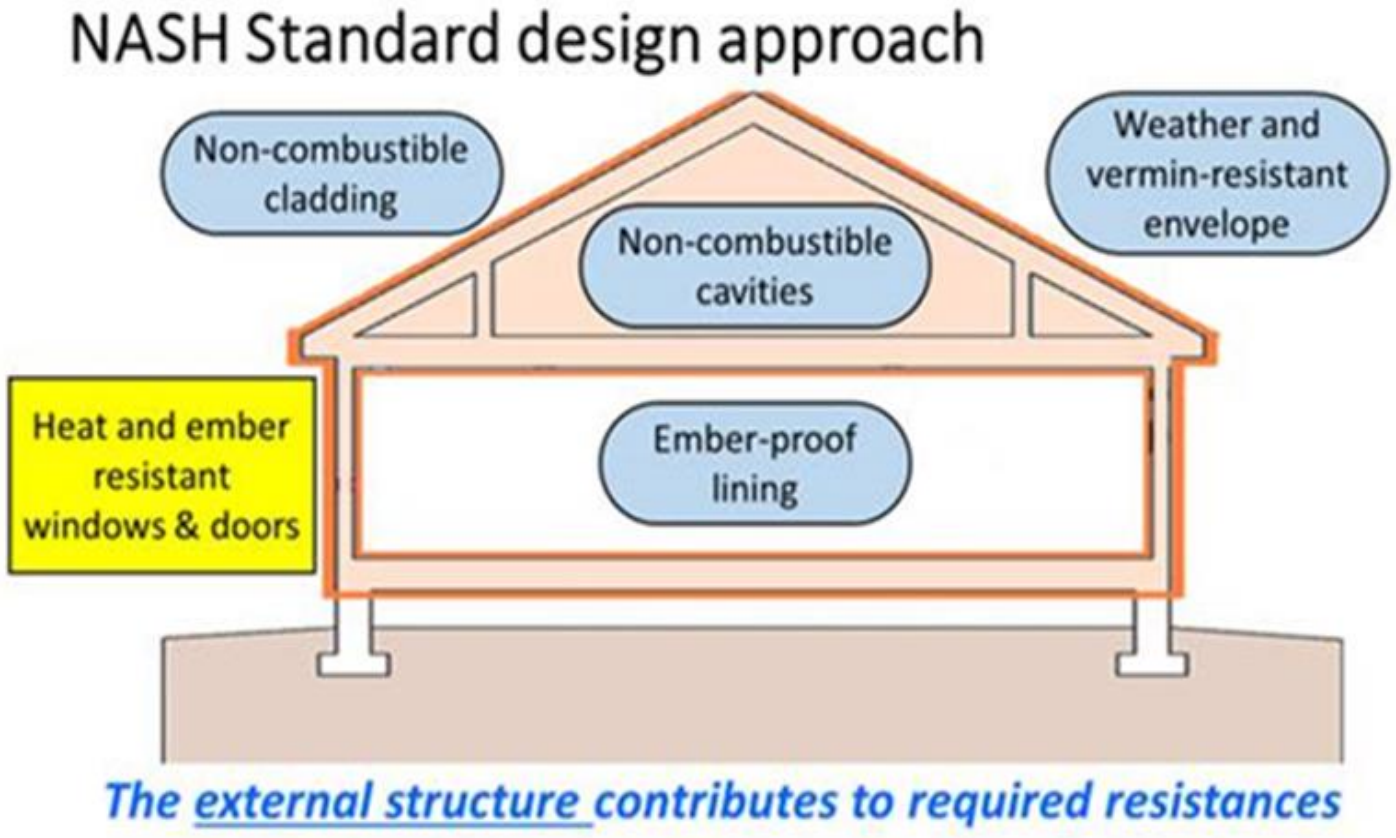
NASH Bushfire Standard

1. Developed to meet the Performance requirements of the NCC
2. Non-combustible construction
3. Full scale test by CSIRO, Mogo NSW (image)
4. Referenced standard within NCC, alongside AS 3959. (NCC Vol Two: Part 3.10.5.0)
5. DtS solution
6. Covers steel framed houses with steel roof cladding and non-combustible walling

Light gauge steel solutions – NASH Bushfire Standard

Australian Steel Institute

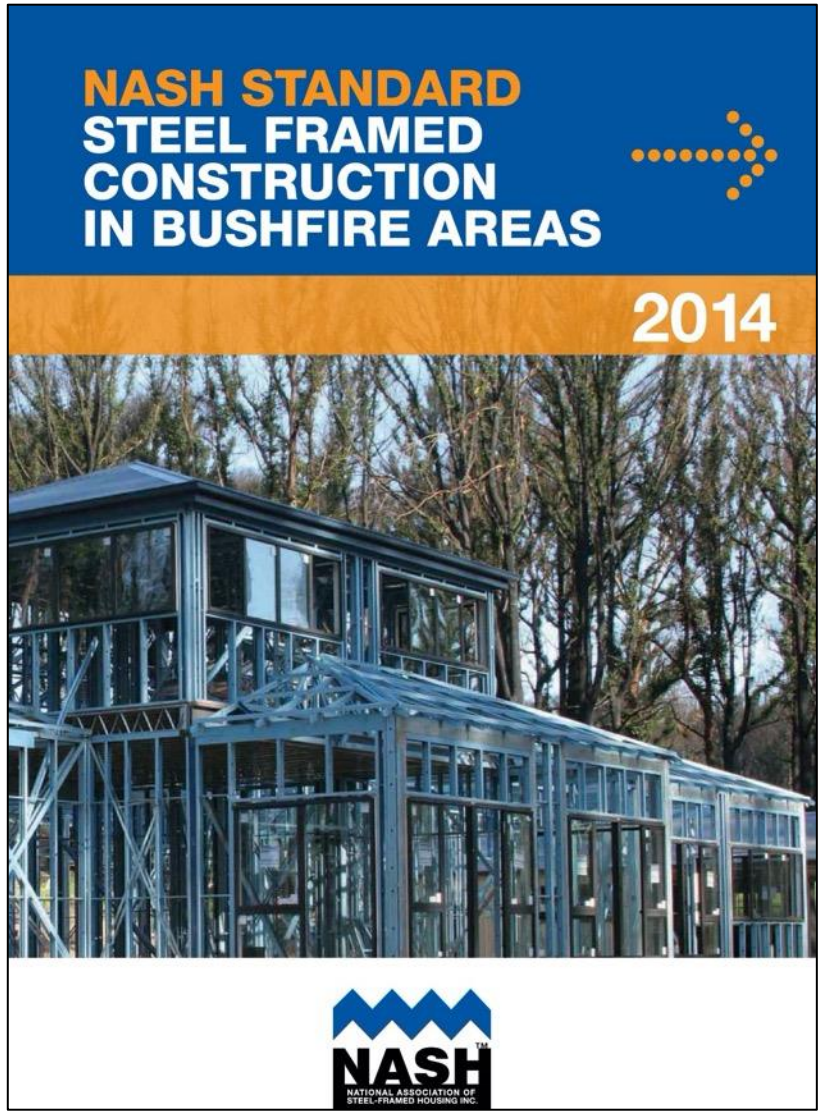
- Based on non-combustible construction
- Use the building envelope to stop ember entry



LIGHT GAUGE
STEEL SOLUTIONS

NASH Bushfire Standard

- Two solutions:
  - BAL-12.5 to BAL-40
  - BAL-FZ
- Windows and doors to AS 3959
- Built using normal building practices & standard materials
- Robust and cost effective solution
- Referenced in the NCC as DtS solution since 2015



https://www.nash.asn.au/nash/publications/nash-standards

LIGHT GAUGE
STEEL SOLUTIONS

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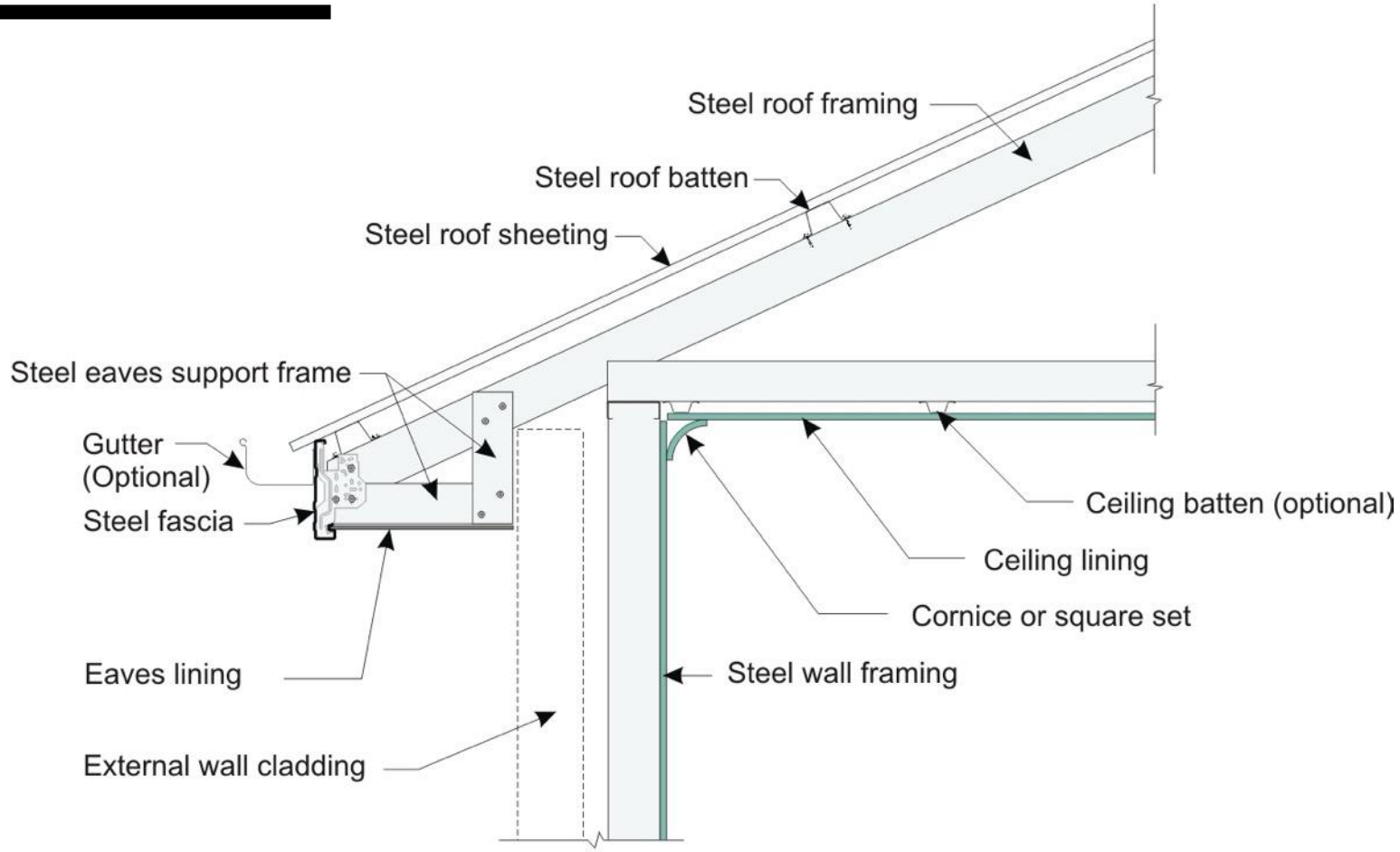
NASH Bushfire Standard

Roof detail
(BAL-12.5 to BAL-40)



LIGHT GAUGE
STEEL SOLUTIONS

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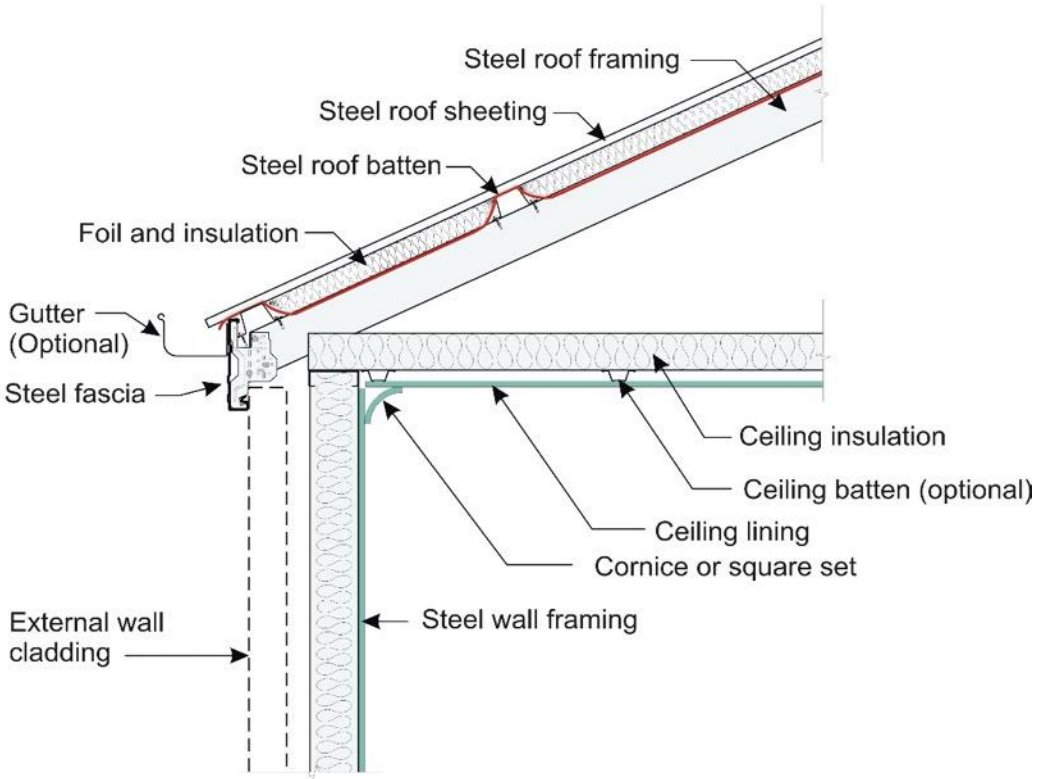
NASH Bushfire Standard - Solution for roof BAL-FZ:

- Steel roof cladding screw fixed
- Reflective foil backed insulation min R1.3
- Ceiling insulation: Glass wool min R3.5
- Ceiling lining: Plasterboard / fibre cement

Wall options:

- Brick veneer, masonry walls
- Steel cladding with 10 mm external plasterboard shield
- Other non-combustible claddings per AS 3959



LIGHT GAUGE
STEEL SOLUTIONS

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NASH Bushfire Standard – major proposed changes: (expect changes referenced in NCC2022)

- Storage platforms in ceilings not allowed
- Gives solutions for tiled roof for BAL-12.5 to BAL-40
- Extends roof pitches to cover all roofs for BAL-FZ
- Extends solution to cover cathedral ceilings in BAL-FZ
- Gives solutions for Class 10a buildings (garages/sheds)
- Covers roof skylights/windows
- Clarified requirements for AC and service ducting

GENERAL **PRINCIPLES**

- For bushfire resistance, building materials & components should be:
  - Non combustible
  - Fit to resist extreme conditions to which they will be exposed

- Critical: a non ember penetrable outer shell; build to resist ember attack; Kate Cotter (CEO) BBCA

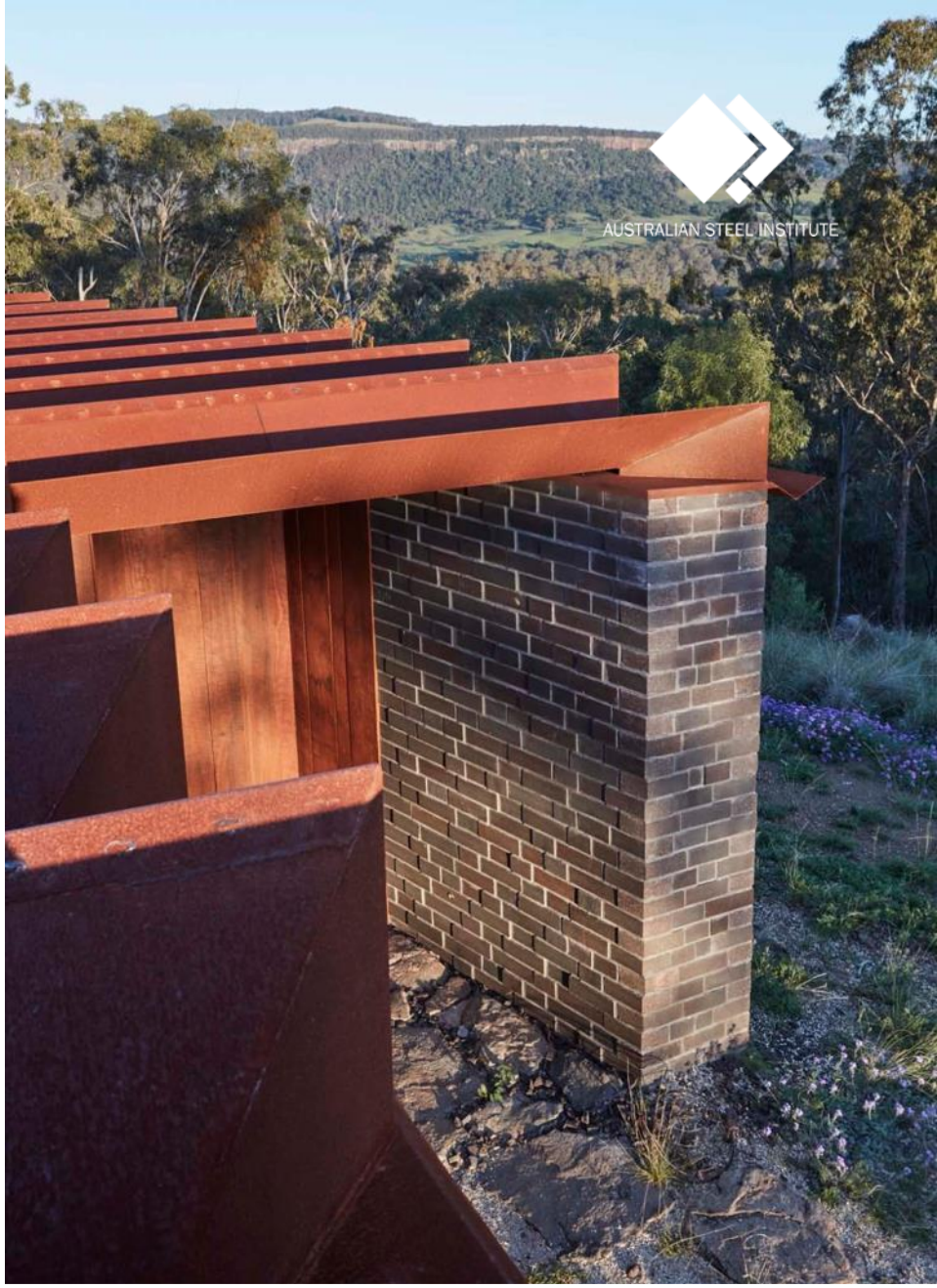
- Good design can dramatically reduce the risk of house ignition, provide durability & resistance – Architects have a critical role

- Steel can be used in a sustainable way providing a long product lifecycle, with high fire resistant outcomes

- Balance sheet approach: build for long term house equity, not short term cost; David Cox (Cox Architects) **Bushfires – Assets & Liabilities**; **Sourceable**; David Cox on 28.09.20

- Fire Engineered Performance Solutions can provide greater resistance (builds in time!) and long term ROI

- Plan the house build materials and the the area around the property



STEEL SUMMARY

Steel is an excellent option in bushfire prone areas:

- Cannot be ignited
- Doesn't add fuel to the fire
- Strength, quality & durability
- Low maintenance & long life cycle
- Infinitely recyclable, re-usable
- Wide design flexibility
- Strong, durable & resistant to climatic conditions
- Widely available in building products and systems which provide design flexibility
- Excellent material for well designed bushfire barrier solutions: wall cladding; sub floor; roofing; shutters; material connections etc.
- Value add qualities: systems with cost effective approaches; & other protective elements - termites

FINALLY…..

- “Homes in bush fire prone areas which: resist ignition, add no fuel to fire, remain strong & secure in all conditions represent better value for owners & the community” (Ken Watson, NASH)
- “Steel and other non-combustible composite materials working together provide excellent fire-resistant solutions” (David Cox, Cox Architects)
- Bushfire protection starts with good design…
- So, fire resistance design and selection of materials and building systems, siting home, is the responsibility of Architects & Structural Engineers:
  - *OVER TO YOU !!*

Arthurs Seat Hill House, Architect: Tandem Design Studio

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QUESTIONS?

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ASI REFERENCES

- Steel in architecture: https://www.steel.org.au/focus-areas/steel-in-architecture/
- https://www.steel.org.au/resources/elibrary/resource-items/steel-framing-perfect-in-bushfire-prone-areas/
- https://www.steel.org.au/focus-areas/steel-and-fire/
- General steel compliance: https://www.steel.org.au/focus-areas/quality-and-compliance/
- Compliance for Government: https://www.steel.org.au/focus-areas/quality-and-compliance/nsscs-for-clients-and-government/
- ASI eLearning portal: https://www.steel.org.au/resources/elearning/
- ASI eLibrary: https://www.steel.org.au/resources/elibrary/

References – ASI eLearning & Case Studies

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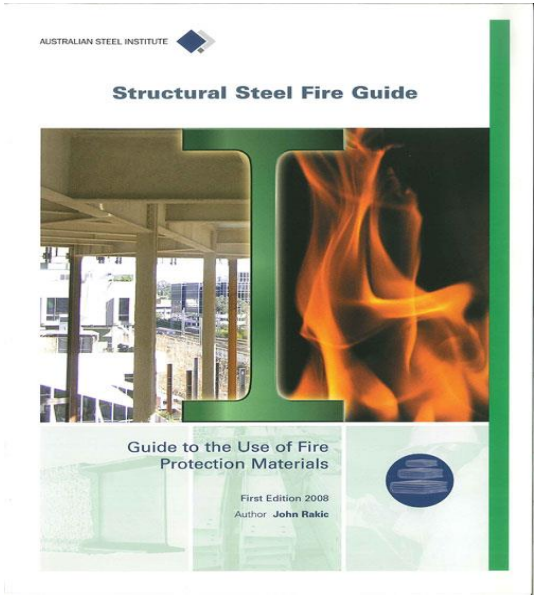
https://www.steel.org.au/resources/elearning/

https://www.steel.org.au/resources/elibrary/



References – Standards & Reports

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- **NASH Bushfire Standard :** Being optimised based on original testing and will include class 10a buildings; https://www.nash.asn.au/nash/publications/nash-standards

- **AS 3959 :** Construction of buildings in bushfire-prone areas; Standard already scheduled to be revised and review will now incorporate any 'learnings' from recent fires.
  Standards Australia has recently made this standard available free to assist with bushfire recovery effort.

- **NCC Bushfire Verification Method Handbook**: http://www.abcb.gov.au/resources/education-training/

- **AS/NZS 4600 : Cold Formed Steel Structures**; https://www.standards.org.au/standards-catalogue/sa-snz/building/bd-082/as-slash-nzs--4600-colon-2018

- **2009 Victorian Bushfire Royal Commission Final Report :** http://royalcommission.vic.gov.au/Commission-Reports/Final-Report.html

- **ABCB Guide :** Structural Reliability Handbook; http://www.abcb.gov.au/Resources

- **NCC (BCA) 2016 – Vol 1, Specification A2.3 :** Clause 2(d)(i) references AS4100 as method for determining FRL of steel structures

- **AS 1530 :** Methods for Fire Tests on Building Materials; Standards Aust 1994

References - General

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- **Bushfires – Assets & Liabilities**; Sourceable; David Cox (Cox Architects); 28.09.20
- **Fire Resistance of Steel Frames**; CIB; Sukumoto, Y, Nishigaki T, Ikeda K; 2003
- **Landscape & Building Design for Bushfire Areas**; CSIRO; Dr Caird Ramsay, Lisa Rudolph; 2003
- **Structural Steel Fire Guide**; Guide to the Use of Fire Protection Materials, John Rakic; 2008
- **Planning for Bushfire Protection**; NSWRFS; 2019
- **Steel Design for Fire Ratings**; Ferm Engineering, Steve Burton; ASI webinar series; 2016
- **Fire Resistance for Buildings**; Holmes Fire, Dr Linus Lim; ASI webinar series; 2017 & 2018
- **International Fire Engineering Guidelindes**; https://www.abcb.gov.au/Resources/Publications/Education-Training/International-Fire-Engineering-Guidelines
- **Investigation of Bushfire Attach Mechanisms Resulting in House Loss in ACT Bushfires 2003**; Rachael Blanch & Justin Leonard; April 2005

APPENDIX

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BlueScope Steel Product Solutions for Bushfire Areas

NASH Bushfire Standard

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BAL-FZ materials and systems

The following materials and systems can be utilised to comply with the Standard for each BAL. For full details, other situations and requirements, use figure numbers as a guide and refer to NASH Bushfire Standard.

Roof System	
Material	**Application**
COLORBOND® steel ZINCALUME® steel	Roof Sheeting (Conforming to AS 1562.1) Flashing (Conforming to AS 1562.1) Fascia and Gutter (Conforming to AS/NZS 3500.3) Ventilators Eaves Lining
TRUECORE® steel	Framing (NASH Standard Pt 1 or Pt 2) Battens (NASH Standard Pt 1 or Pt 2)

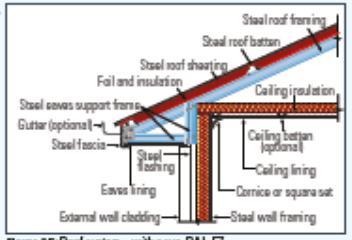

Figure 2.5: Roof system – with eave, BAL-FZ

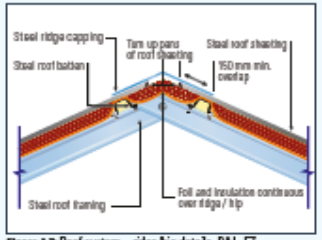

Figure 2.7: Roof system – ridge/hip details, BAL-FZ

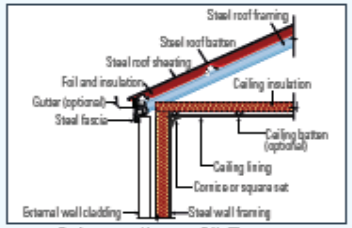

Figure 2.6: Roof system – without eave, BAL-FZ

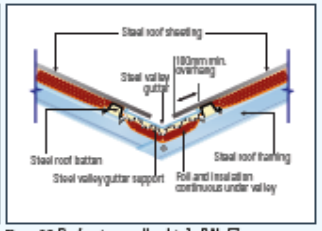

Figure 2.8: Roof system – valley details, BAL-FZ

Wall System	
Material	**Application**
COLORBOND® steel ZINCALUME® steel	Cladding (Conforming to AS 1562.1) Flashing (Conforming to AS 1562.1) Downpipes
TRUECORE® steel	Framing (NASH Standard Pt 1 or Pt 2) Battens (NASH Standard Pt 1 or Pt 2)

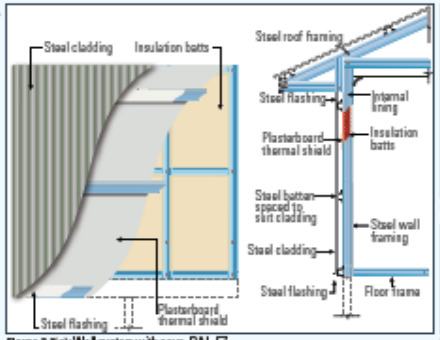

Figure 3.3(a): Wall system with eave, BAL-FZ

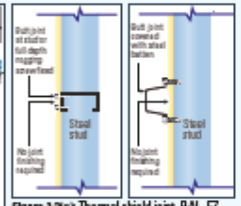

Figure 3.2(c): Thermal shield joint, BAL-FZ

Figure 3.3: Steel skirt flashing

Floor System	
Material	**Application**
GALVASPAN® steel ZINC HI-TEN® steel TRUECORE® steel	Steel Bearer (NASH Standard Pt 1 or Pt 2) Floor Joist (NASH Standard Pt 1 or Pt 2)
Post-galvanised steel	Steel Post (NASH Standard Pt 1 or Pt 2)

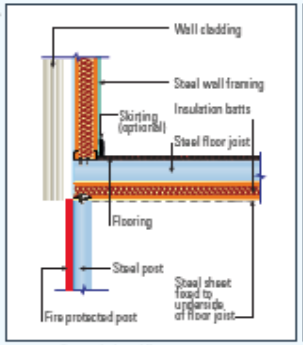

Figure 4.2: Suspended steel floor system, unenclosed, BAL-FZ

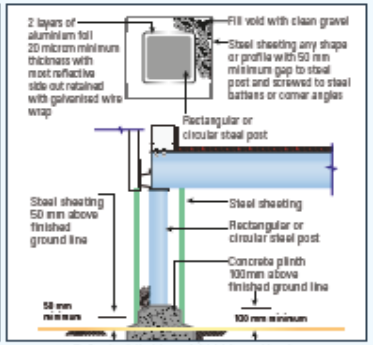

Figure 4.3(a): Reflective foil with steel shield thermal barrier

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Bushfire Attack Levels

Bushfire Attack Levels (BALs) refer to heat flux exposure levels and are summarised below:

Bushfire Attack Level (BAL)	Classified vegetation within 100m of the site and heat flux exposure thresholds	Description of predicted bushfire attack and levels of exposure (AS 3959)
BAL-LOW		There is insufficient risk to warrant specific construction requirements
BAL-12.5	≤ 12.5 kW/m²	Ember attack
BAL-19	> 12.5 kW/m² ≤ 19 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL-29	> 19 kW/m² ≤ 29 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL-40	> 29 kW/m² ≤ 40 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with some increased likelihood of exposure to flame from the fire front
BAL-FZ	> 40 kW/m²	Direct exposure to flames from fire front in addition to heat flux and ember attack

AS 3959 contains procedures for determining the Bushfire Attack Level (BAL) on a building site. However, the BAL is ultimately a matter for the Building Authority in the particular state or territory. For example, in designated bushfire prone areas in Victoria, a minimum of BAL-12.5 applies. In NSW, BALS are determined in accordance with the Planning for Bushfire Protection (NSW RFS).

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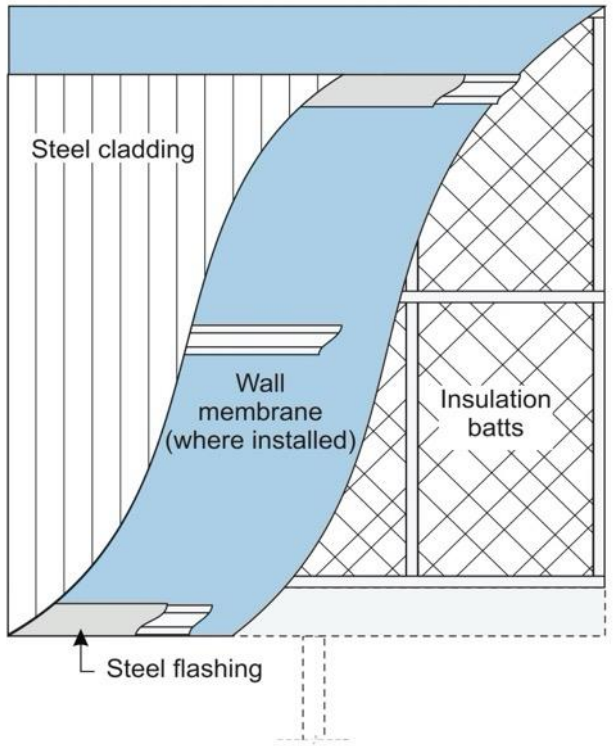
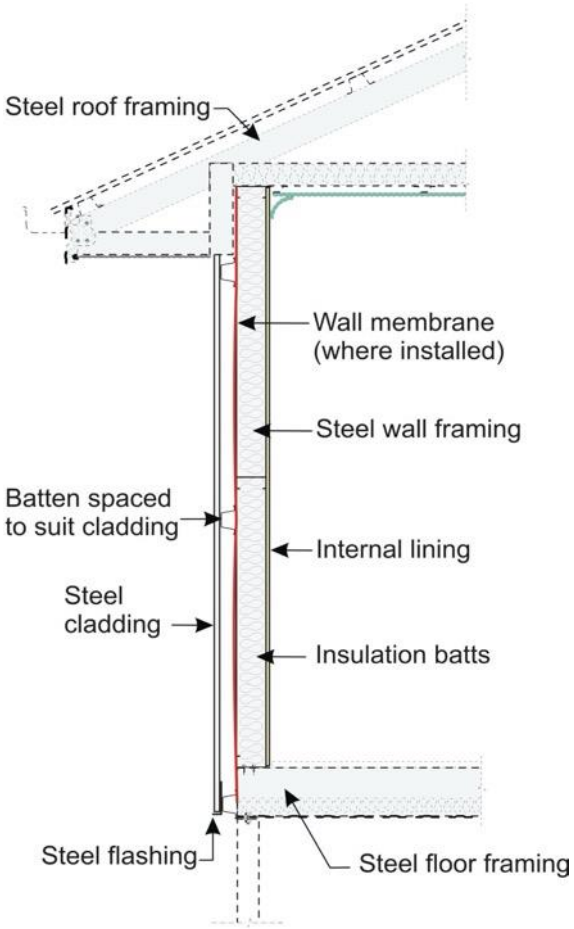
AUSTRALIAN STEEL INSTITUTE

NASH Bushfire Standard

Steel wall solution
(BAL-12.5 to BAL-40)





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Light gauge steel for mid-rise construction:

- Exciting recent developments for cost-effective quality medium density solutions
- Significant research undertaken at UoW (systems design) and QUT (fire solutions)
- Bluescope developing implementation network

See: https://www.steel.org.au/focus-areas/cold-formed-light-gauge-steel/cold-formed-steel-for-mid-rise-construction/