FireHard Canada

Technical Bulletin TB-01

Assembly Design for Wildfire Resistance

Mitigation categories, ventilation decision framework, hot roof assemblies, wall assembly design, and intersection detailing for Canadian climates

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This guide is free. It always will be.

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1. Mitigation by Work Category

The FireHard WER system organises specifications by building element and exposure level. This bulletin provides an alternative navigation by work category — the type of trade or activity involved. The same specifications apply; the entry point differs.

Category 1: Cleaning, Detailing, and Ground Cover

Maintenance-level work requiring no construction skills, no permits, and minimal cost. Primarily WER-1 scope.
Scope: clearing combustible debris from Zone 1A (0–1.5m), cleaning gutters and roof valleys, sealing gaps at penetrations with non-combustible caulk or backer rod, installing mesh screens on existing vents (≤3mm at WER-1, ≤2mm at WER-2+), removing combustible storage from under decks and eaves, maintaining non-combustible ground cover within 1.5m, and inspecting rain screen cavity bottoms.

Typical cost: $50–$200 in materials. Cross-reference: WER-1 Design Guide, Self-Assessment for Existing Homes, Module 5.

Category 2: Attached Decks, Fences, and Accessory Structures

Structures attached to or within 3m of the home — fire bridges that carry flame from ground-level fuel to the building envelope. Primarily WER-2 and WER-3 scope.
Scope: replacing combustible decking with non-combustible alternatives, installing NC deck posts and structural connections, replacing or detaching combustible fencing within 3m, hardening carport and pergola attachments, installing NC flashing at deck-to-wall connections, and addressing under-deck enclosure.

Typical cost: $3,000–$30,000 (decks), $2,000–$8,000 (fencing). Cross-reference: Module 4, WER-2 Design Guide Section 4, WER-3 Design Guide Section 4.

Category 3: Windows, Walls, and Roof Assemblies

The building envelope. Core of WER-2 through WER-4 work, highest cost and greatest fire resistance benefit.
Scope: upgrading windows to tempered glass (WER-2+) or fire-rated assemblies (WER-4), replacing combustible cladding, installing Type X gypsum sheathing behind cladding (WER-3+), upgrading cavity insulation to mineral wool (WER-3+), replacing roof covering to Class A non-combustible, installing NC rain screen systems, and addressing trim and intersection detailing (see Section 4).

Typical cost: $15,000–$80,000+. Cross-reference: Module 1, Module 6, Module 2, New Construction Guide.

Category 4: Soffits, Fascia, and Ventilation

The roof-to-wall intersection — the most vulnerable zone during wildfire. Embers accumulate in eave overhangs, radiant heat concentrates at re-entrant corners, and ventilation openings provide direct pathways into the attic.
Scope: replacing combustible soffit and fascia with NC alternatives, upgrading attic vents to ASTM E2886 ember-resistant (WER-2+), installing baffled vent designs (WER-3+), enclosing open eaves

(WER-2+), addressing the ventilation-versus-ember-protection tension (see Section 2), and considering unvented roof assemblies for new construction (WER-3+, see Section 3).

Typical cost: $3,000–$15,000 (soffit/fascia), $500–$3,000 (ventilation). Cross-reference: Module 2, Module 3.

2. Ventilation and Ember Protection

2.1 The Core Tension

Every attic vent opening is an ember entry point. In Canadian climates, attic ventilation is critical for moisture control, ice dam prevention, and sheathing durability. Sealing vents without addressing moisture consequences can cause damage faster than wildfire.

2.2 WER Ventilation Progression

WER-1: Screen all attic vents with corrosion-resistant NC mesh, ≤3mm openings. Ensure all vents are functional.
WER-2: Upgrade to ASTM E2886-rated ember-resistant vents (Brandguard, Vulcan, O'Hagin). Baffled designs preferred. Eliminate redundant gable vents where soffit-to-ridge ventilation is adequate.

WER-3: ASTM E2886-rated vents required on all openings. Baffled ridge vents. Corrosion-resistant steel or bronze mesh only (no aluminium per AS 3959). Eliminate gable vents; use balanced soffit-to-ridge ventilation. For new construction, unvented assembly is recommended (see Section 3).

WER-4: All WER-3 requirements. For new construction, unvented roof assembly is the recommended approach. For retrofit, ASTM E2886 baffled vents on all openings plus partial sealing strategy (see Section 2.4).

2.3 Decision Framework

New construction, WER-1/2: Standard vented cold attic. ASTM E2886 vents at WER-2. Balanced soffit-to-ridge ventilation. No gable vents.
New construction, WER-3: Unvented conditioned attic (hot roof) recommended. Eliminates all vent openings. If vented attic is used, all vents must be ASTM E2886 with baffled designs.

New construction, WER-4: Unvented conditioned attic (hot roof) recommended. Ember entry risk at this exposure level cannot be adequately mitigated by vent screening alone.

Retrofit, any WER level: Existing vented cold attics cannot easily be converted to unvented assemblies. Retrofit progression: screen existing vents → replace with ASTM E2886 → eliminate gable vents and install baffled designs → at WER-4, consult a qualified professional regarding partial sealing strategies combined with mechanical ventilation.

2.4 Partial Sealing Strategy for Retrofit

Where full conversion to an unvented assembly is not feasible:
Seal all soffit vents and gable vents. These face the wind-driven ember flow and are the primary entry points.

Maintain ridge ventilation only, using ASTM E2886-rated baffled ridge vents. Ridge vents face upward, receive significantly fewer embers than soffit or gable vents.

Install a vapour-open but fire-resistant membrane over the ridge vent opening at the roof deck level — exterior glass-mat faced gypsum board or a tested fire-resistant vapour-open membrane. This allows moisture to diffuse upward while blocking ember intrusion.

This approach reduces net free vent area below code minimum for conventional vented attics. Moisture performance must be verified — acceptable where the ceiling air barrier is tight, the attic has no significant moisture sources, and no ductwork is routed through the attic. If in doubt, consult a building envelope professional.

Reference: Building Science Corporation BSD-149, GM-2101, BSI-129.

3. Hot Roof Assembly for New Construction

3.1 Description

A hot roof (unvented conditioned attic) moves the insulation and air/vapour barrier from the ceiling plane to the roof deck. The attic becomes conditioned space within the building envelope. All soffit, ridge, and gable vents are eliminated.
This is the most effective strategy for eliminating ember entry through the roof assembly.

3.2 Wildfire Relevance

In conventional vented attics, wind-driven embers enter through soffit and ridge vents, travel through the attic, and ignite roof sheathing or framing from the inside. IBHS research demonstrates that even ASTM E2886-rated vents can be overwhelmed under extreme ember density and wind pressure. An unvented assembly eliminates this pathway entirely — no openings, continuous air barrier at the roof deck.

3.3 Assembly Options for Canadian Climates

Canadian climates (IECC Zones 5–8, NBC Zones 4–8) require careful moisture management. The roof deck must remain warm enough to prevent condensation.
Option A — Closed-cell spray foam at underside of roof deck. Provides air barrier, vapour retarder, and insulation in one application. For Climate Zone 6, minimum 50% of total roof R-value must be air-impermeable. For R-50 total (NBC minimum): minimum R-25 closed-cell spray foam at roof deck, balance as mineral wool batts below. Fire note: closed-cell spray foam is combustible; specify 15-minute thermal barrier (12.7mm gypsum) on underside for WER-3+.

Option B — Rigid mineral wool insulation above roof deck. Rigid insulation above sheathing with nailbase above. Roof deck stays warm because insulation is on the exterior. Non-combustible mineral wool board (Rockwool TopRock) provides outstanding fire resistance. Recommended approach for WER-3+ new construction.

Option C — Hybrid: spray foam at roof deck plus mineral wool batts below. Minimum 50mm closed-cell spray foam at roof deck (air barrier/vapour retarder), mineral wool batts between rafters for balance of R-value. Practical compromise for WER-3 where above-deck insulation is not feasible.

3.4 Eave Design for Unvented New Construction

With no soffit ventilation required, the eave overhang can be designed as a continuous fire barrier: Soffit: continuous NC panel (fibre cement or steel) with no vent openings. Fascia: NC (metal or fibre cement). Underside: continuous fire barrier from wall face to fascia, no gaps, no penetrations. Gutter: NC metal with gutter guard.

This eliminates three vulnerabilities simultaneously: soffit vent ember entry, combustible soffit ignition, and debris accumulation in eave cavities.

4. Wall Assembly Design

4.1 NC Cladding over Mineral Wool Continuous Insulation

The recommended wall assembly for WER-3+ new construction and high-priority retrofit.
Assembly (outside to inside): NC cladding (fibre cement, metal panel, or masonry veneer) → rain screen cavity on metal furring (hat channel) → weather-resistive barrier (WRB) → mineral wool continuous insulation board (Rockwool ComfortBoard 80, R-6 per 25mm) → Type X glass-mat faced exterior gypsum sheathing (15.9mm) → wood or steel framing with mineral wool batt insulation in cavities → interior vapour retarder → interior gypsum board.

Fire performance basis: Rockwool ComfortBoard 80 is non-combustible per ASTM E136, Euroclass A1, melting point >1000°C. It is listed by the California State Fire Marshal for WUI construction and has tested 1-hour fire-rated exterior wall assemblies per UL 263/ASTM E119 in combination with gypsum sheathing. The assembly provides three NC layers between exterior and framing. Mineral wool maintains position and thermal resistance even after cladding failure. The 2021 IWUIC and Building America Solution Center specifically recommend mineral wool CI behind NC cladding for WUI areas.

Thermal benefit: R-6 to R-12 continuous insulation (depending on thickness) with zero thermal bridging at studs. Can reduce heating costs 15–25% in BC interior and prairie climates.

4.2 Exterior Gypsum Sheathing and Moisture

Standard interior gypsum board (paper-faced) absorbs moisture and supports mould. It must never be used as exterior sheathing.
Glass-mat faced exterior gypsum sheathing (Gold Bond eXP Fire-Shield, Georgia-Pacific DensGlass) is designed for exterior exposure. Glass-mat facing eliminates the organic food source for mould. The gypsum core is silicone-treated to resist moisture absorption. Rated for direct weather exposure up to 12 months during construction.

In the recommended assembly, the gypsum sheathing sits behind the WRB and behind the mineral wool CI. It receives virtually no direct moisture exposure. The WRB provides the primary moisture barrier; the mineral wool is hydrophobic and drains freely; the gypsum handles incidental vapour diffusion.

Placement: directly over framing, replacing OSB or plywood as the sheathing plane. If structural bracing is required (shear wall), use gypsum in combination with metal strap bracing, or OSB at shear wall locations only.

Vapour barrier: the interior polyethylene vapour barrier remains in its standard location on the warm side. The exterior gypsum sheathing does not require a separate vapour barrier and must not have one. The assembly must dry to the exterior through the vapour-permeable WRB and ventilated rain screen cavity. Do not trap moisture between two vapour barriers.

4.3 Rain Screen Cavities

Rain screen cavities are essential for moisture management — drainage and drying behind cladding. The cavity also creates a vertical channel that can carry flames and hot gases upward behind cladding during a fire.
Current WER specifications: WER-1: standard rain screen per code. WER-2: screen bottom of cavity with NC mesh (≤3mm). WER-3+: metal furring (hat channel) instead of wood strapping, bottom screened ≤2mm NC mesh, no combustible material in cavity.

Note on fire stopping within the cavity: horizontal fire stops (intumescent strips, compression-fit mineral wool strips) have been proposed to slow vertical fire spread within rain screen cavities. However, solid fire stops within the cavity will impede drainage and airflow, diminishing the rain screen's primary function. The recommended approach is: NC mesh screening (≤1/16" / 1.6mm) at top and bottom of the cavity per Building America Solution Center guidance, metal furring (hat channel) rather than combustible wood strapping, and NC continuous insulation behind the cavity (mineral wool) which limits available fuel within the cavity zone. Where the cladding, furring, insulation, and WRB are all non-combustible, the cavity contains no fuel to sustain vertical fire spread. This is the preferred design approach rather than obstructing the cavity.

4.4 Trim, Termination, and Intersection Detailing

Trim and termination details are where otherwise well-designed assemblies fail during wildfire. Non-combustible walls with combustible trim provide continuous pathways to vulnerable points.
Window and door trim: WER-1: existing wood trim acceptable if maintained. WER-2+: NC trim within 400mm of grade. WER-3+: all exterior trim NC (fibre cement, aluminium, composite, or formed metal). PVC/vinyl trim melts and drips burning material — not acceptable at WER-3+.

Corner trim and J-channel: NC at WER-3+. Metal J-channel and corner trim are available from cladding manufacturers.

Wall-to-roof intersection: critical fire pathway. Cladding termination at roof/soffit line must be tight with NC metal flashing, lapped to shed water and block embers.

Wall-to-foundation intersection: most exposed to ground-level embers and radiant heat. Cladding termination at foundation must be sealed against ember entry, NC, and set back from combustible ground-level materials.

Penetration sealing: WER-1: NC caulk. WER-2+: NC fire caulk or intumescent sealant. WER-3+: fire-rated putty pads or intumescent collars at penetrations through the gypsum sheathing fire barrier.

Flashing at intersections: every wall-to-roof, wall-to-deck, wall-to-foundation, and wall-to-window intersection requires NC flashing correctly lapped for both water and ember protection. Self-adhered membrane acceptable behind cladding; exposed flashing at terminations must be metal.

4.5 Retrofit Eave Enclosure

WER-1: clean debris from eave areas, screen soffit vents ≤3mm.
WER-2: replace combustible soffit and fascia with NC. Install ASTM E2886-rated soffit vents. Enclose open eaves.

WER-3: all WER-2 measures plus: wrap existing wood rafter tails with NC cladding or cap with metal, install continuous NC soffit from wall face to fascia with no gaps, replace all soffit vents with

ASTM E2886 baffled designs, consider reducing total soffit vent area and compensating with upgraded ridge ventilation (see Section 2.4).

WER-4: all WER-3 measures. Engage a building envelope professional to assess partial or full conversion to unvented assembly. If not feasible, implement partial sealing strategy (Section 2.4) with mechanical ventilation to supplement reduced passive ventilation.

Material notes: fibre cement soffit (HardieSoffit, Allura) — NC, dimensionally stable, available vented and non-vented. Metal soffit — NC, lightweight; steel preferred at WER-3+ (aluminium melts at 660°C under sustained radiant heat). Vinyl soffit — not acceptable at any WER level in wildfire-prone areas (melts, drips burning material, zero fire resistance).

5. Building Science Integration

Every recommendation in this bulletin has been evaluated against both wildfire resistance requirements and Canadian building science fundamentals — moisture management, thermal performance, ice dam prevention, and vapour control. Wildfire hardening that creates moisture problems, mould risk, or structural deterioration is not hardening.

The preferred assemblies described here are better-performing wall and roof assemblies than conventional Canadian construction on every metric: fire resistance, thermal performance, moisture management, and durability. The additional cost over conventional construction is moderate in new construction (10–20% wall premium, 15–25% roof premium) and significant in retrofit. Thermal performance improvements provide ongoing energy savings, and durability improvements reduce long-term maintenance costs.

About FireHard Canada

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