Protecting Your Community from Wildfire

Materials Acceptable for Use in the Wildland-Urban Interface

M.Y. Ackerman P.Eng.
MYAC Consulting Inc.
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Background

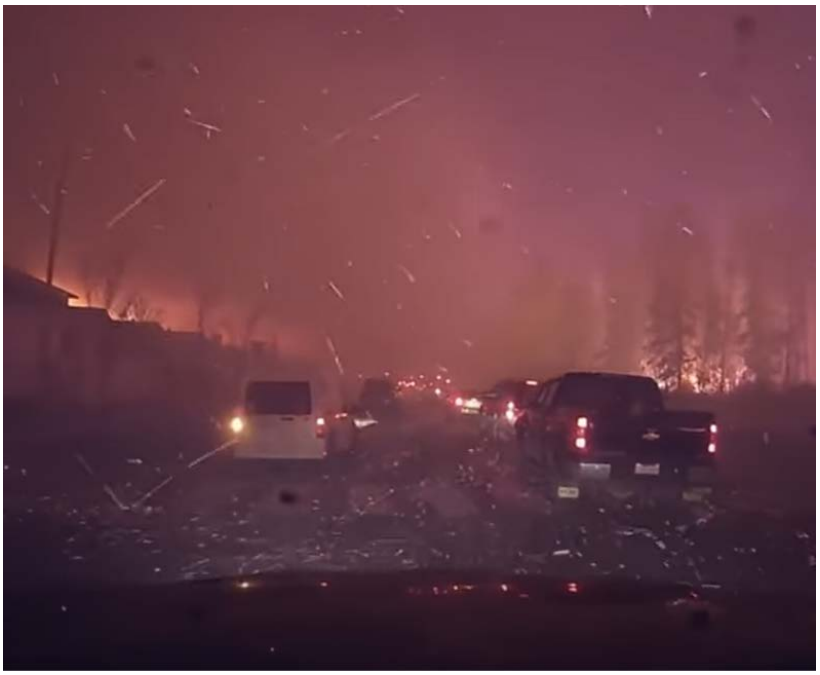
If you have followed the news over the past few years, you will realize that forest fires, either natural or man-caused, have resulted in the loss of thousands of homes in Canada and the United States. If you live in an area that is prone to forest fires, you might wonder why this is.

Forest fires are major natural events that occur throughout North America and indeed around the world and, although the forest services have done a great job of suppressing fires before they grow into uncontrollable events that is not always possible. If conditions are right (extended dry period, low rainfall and wind) there will be multiple fire starts in an area. The fires grow and move under the influence of wind and terrain and the most intense fires, called crown fires, can travel long distances over a short time period.

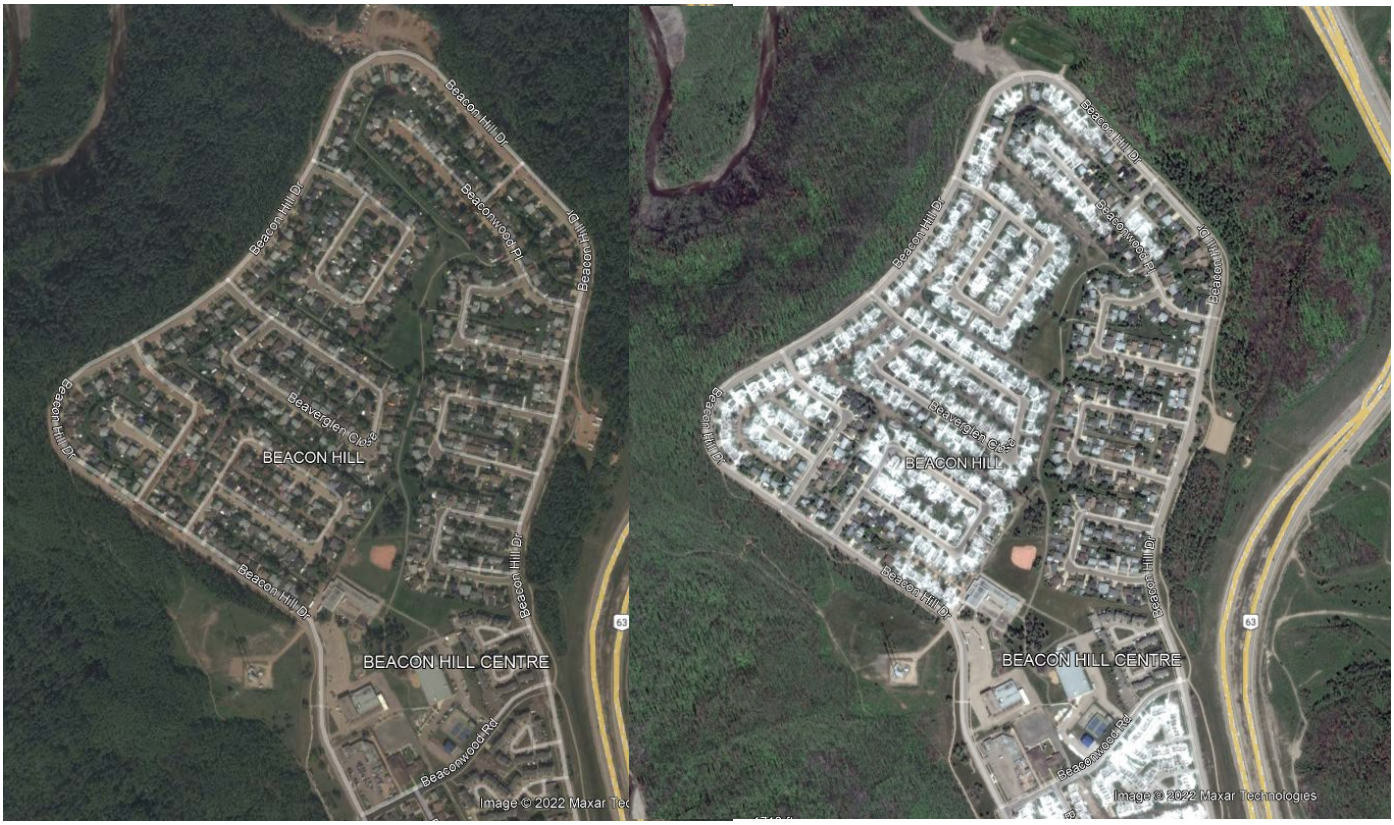
To prevent fires from entering your community your FireSmart group and local fire service have gone into the forested areas, immediately next to your community, and removed some trees and woody material from the forest floor. This has the effect of changing a high intensity crown fire to a surface fire, which is far more manageable. While you might think the prevention job is done – nothing could be further from the truth. While it is very unlikely that a major flame front will be able to enter the city the fire will throw out millions of burning embers while it moves. The burning embers are carried aloft by the rapidly rising hot gases above the fire and are then transported down-wind ahead of the main fire. These burning embers, which range in size from a few mm in length to much larger, eventually land on the ground or a roof or in a foundation planting and, if the landing site is also dry and combustible, will start a new fire. Ember started fires take a while to amount to anything and if someone is around can easily be extinguished. The trouble is that there are millions of these embers and usually when a community is threatened and evacuation order goes into place – meaning everyone has to leave. What happens then is predictable; small spot fires turn into larger surface fires, eventually find a structure (fence, deck, garden shed, siding of a building), and start a structure fire. From that point onward the burning structure releases sufficient energy to ignite the next house and process will repeat itself through the community.

There is nothing we can do about the millions of embers produced by a wildfire but there is something we can do to lessen the possibility of embers starting a house fire. We recognize that there are a number of vulnerable parts of a structure. The roof, siding, decks, fences and plantings immediately adjacent to the foundation are all potential ignition sites. We can lessen the chance of ignition by either building these from less flammable materials or in the case of foundation plantings removal all together.

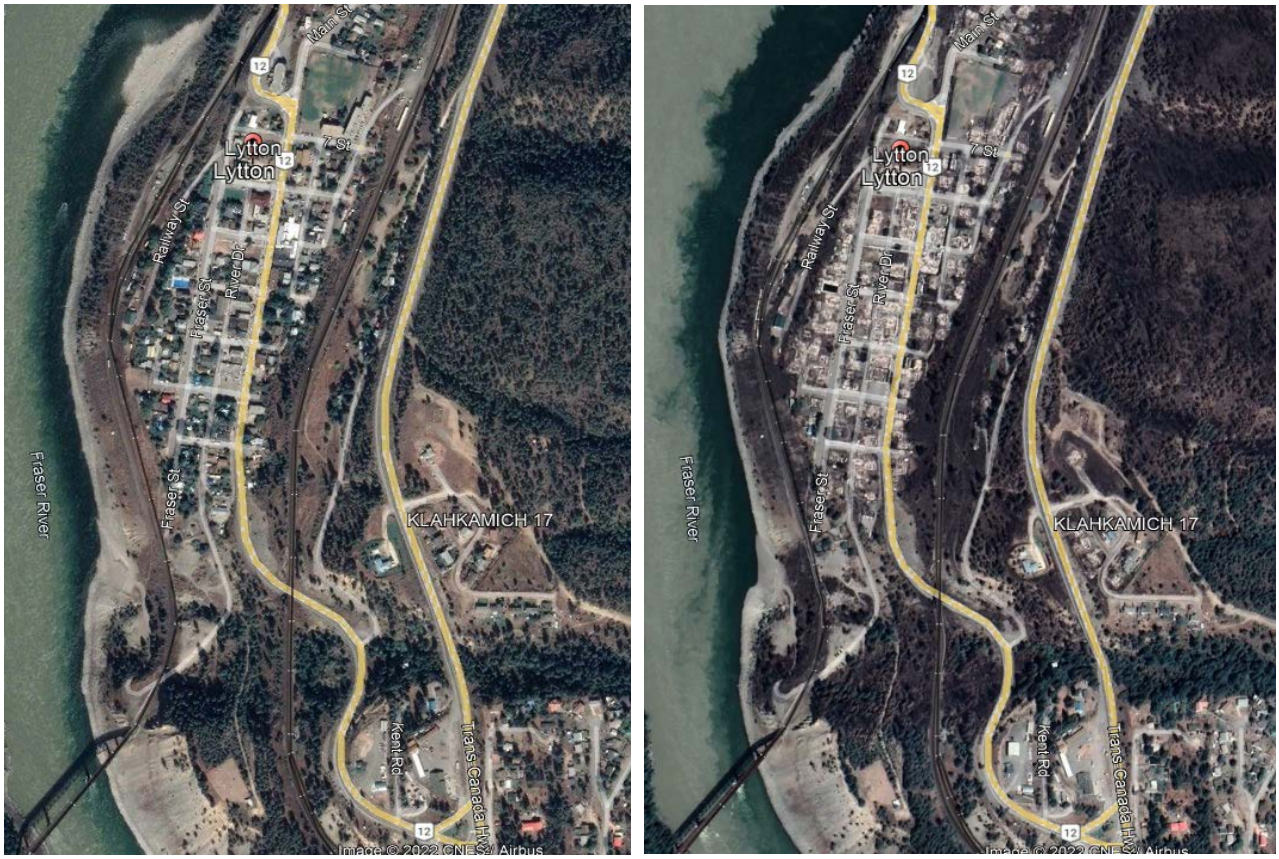
The City of Nelson has produced a list of materials for use in houses that are less flammable and as a result are less likely to allow embers to ignite a building. The use of these types of materials lessens the chance of a major catastrophe but it is only part of the solution. Fires can also spread from building to building and what that really means is that community protection is everyone's responsibility. Making the structures less flammable does not mean that we can stop every fire but it does lessen the number of structures burning at once and gives first responders a chance to deal with them.



Ember storm during evacuation of Ft. McMurray, Alberta (image source YouTube video of Ft. McMurray evacuation)



Community of Beacon Hill, Fort McMurray, Alberta before and after 2016 wildfire (~2400 structures lost, image source Google Earth)



Lytton, BC before and after 2021 wildfire (image source Google Earth)

There are a number of steps that need to be taken to prevent disasters such as have occurred in Canada and, indeed, around the world. Building structures that are either less susceptible to ignition from embers or less likely to result in structure-to-structure fire spread means using materials that are less flammable. To that end, the City of Nelson has compiled a list of materials that are better suited for use in areas where embers from a wildfire are likely to land. The list is not exhaustive, as not all manufactures have had materials independently tested to ensure lower flammability – nor indeed is this necessary. For materials that are inherently non-combustible (metals, concretes) testing is not needed. Other materials, such as composites are less flammable, but that does not mean that they cannot burn given the right conditions – it simply means that they are harder to ignite and, once ignited, spread fire at a lower rate.

Vulnerable parts of homes and outbuildings are identified in numerous documents but, in reality, there are few documented studies of how fire gets into homes and destroys a neighborhood. The best we can do with readily available building materials is to prevent fire entry into the building and, if we fail at that, limit structure to structure fire spread by choosing better, more resilient, materials.

The most vulnerable zone around a building or structure is the 1-2m strip around the foundation. Foundation plantings and mulched beds can be very receptive to embers, especially if the mulch used is flammable, the plants in the beds are stressed due to high temperatures and/or limited water supplies or the planted material is of any significant height. We have all seen cedars and other coniferous plants placed right next to a building and growing to the eaves – these are a recipe for disaster. Even though the

rest the structure may be of less combustible materials the incidence of a relatively large fire in such close proximity is almost guaranteed to breach the soffit and get into the building. Studies of the flammability of mulch has shown that even rubber crumb (something normally thought of as less flammable) can contribute to significant flames close to the building. Foundation treatments should be non-combustible and use materials such as decorative rock to ensure no fire starts near the building. This cannot be emphasized enough – there should be no organic material (plants, mulch) within 1 m of the building foundation and it goes without saying that things like firewood should never be placed against a building.

Making the structure more fire resistant then involves identifying the likely points at which the building envelope could be breached. This depends on the attachments (decks and fences) as well as the proximity to other structures – sheds, detached garages or neighboring houses. The spacing of sheds and detached garages must be examined, not only from the enhanced risk for the owner's property, but also the increased risk to the neighbor's house/outbuildings. When fire runs through a community we have what is known as a "weak link" problem – the weakest link is the most vulnerable structure within a neighborhood – whether it is a garden shed, a detached garage or a house.

Areas that have been identified as vulnerable to embers are as follows:

- Foundation treatment
- Roof
- Walls
- Windows and doors
- Soffits or eaves
- Vents
- Decks
- Attached fences

Roof:

All roof construction should be Class A materials. Class A materials are those that exhibit the minimum flame spread under a set of defined test conditions. Metal roofing is inherently non-flammable but asphalt and asphalt/fiberglass shingles are also considered Class A. That does not mean that given enough energy, asphalt shingles will not burn – indeed they will, but what is does mean is that they are not likely to be ignited by embers.

There are many sources of Class A roofing materials, both local and national. The list of materials below is far from exhaustive and products that have similar characteristics can be included without the need for an independent test report. (What that means is that shingles from ABC company should also be considered Class A (acceptable) if they are essentially the same materials)

Roofing Materials			
Company		Material	Rating
IKO	Various	fiberglass/asphalt	ASTM E108 Class A
Building Products of Canada	Various	fiberglass/asphalt	CAN/ULC S107 Class A
Owens Corning	Various	fiberglass/asphalt	ASTM E108/UL 790 (Class A Fire Resistance)

GAF	Various	fiberglass/Asphalt	UL Class A, Listed to ANSI/UL 790
Vicwest	Various	metal panels, shingles	Inherently non combustible
Marley		concrete tiles	Inherently non combustible
Unicrete		concrete tiles	Inherently non combustible
Tile Roofs Canada	various brands	concrete tiles	Inherently non combustible
		clay tiles	Inherently non combustible
		slate	Inherently non combustible
Certainteed	various brands	fiberglass/asphalt	CAN/ULC S107 Class A

Siding/Wall Covering:

Siding and/or wall coverings must be rated in order to minimize the possibility of ignition from either a nearby burning tree/brush or an adjacent structure. While it would make some sense to allow more flammable materials in situations where either there are no adjacent hazards (either nearby trees/shrubs, structures or decks) the reality is this would result in confusion and make compliance very difficult to enforce. As a result, a list of material types with potential suppliers was developed under the assumption that it should not require additional materials (such as type-X gypsum board) to achieve reasonable fire resistance. That is not to say that other materials or materials systems could not achieve the same goals – just that those systems are perhaps not as common and would require assessment on a case-by-case basis.

There are many non-combustible material options available today and these range from cement board siding, to metal siding to naturally non-combustible materials such as brick, stone and stucco. Any of these should be acceptable in high-risk areas (WUI designated areas). The list of products shown below is by no means exhaustive but really serves to illustrate the wide range of materials that are both suitable and available.

Siding / Wall Covering			
Supplier		Material	Listing
James Hardie	Artisan	Cement board	Chapter 7A California
	Cemplank	Cement board	Chapter 7A California
	Cempanel	Cement board	Chapter 7A California
	Hardieshingle panel	Cement board	Chapter 7A California
	HardiePlank	Cement board	Chapter 7A California
	Artisan	Cement board	Chapter 7A California
	Reveal	Cement board	Chapter 7A California
	Hardie Textured Panel	Cement board	Chapter 7A California
Stucco - Various		Stucco when applied as per Section 9.28 of the BC Building code	Inherently non combustible
Canyon Stone Canada	Faux Stone Veneer		Inherently non combustible
	Natural Stone Veneer		Inherently non combustible

	Thin Brick Veneer		Inherently non combustible
Canadian Stone Industries	Brick Veneer		Inherently non combustible
	Manufactured Stone		Zero flame spread
	Natural Stone		Zero flame spread
	Stone Siding		CAN/ULC S114-18
Allura	panel and shake	Fiber cement	Inherently non combustible
Lux (Wayne building products)		Metal	Inherently non combustible
Timberstone Distribution			
	Environmental Stoneworks	Manufactured Stone	
	Creative Mines	Manufactured Stone	
	TDS Collection	Natural Stone	Inherently non combustible
	Eden Valders	Natural Stone	Inherently non combustible
	Bedrock	Natural Stone	Inherently non combustible
	Kettle Valley	Natural Stone	Inherently non combustible
	Gillis Quarries	Natural Stone	Inherently non combustible
	Modern Stone	Natural Stone	Inherently non combustible
	McNear Brick	Brick Veneer	Inherently non combustible
	Brampton Brick	True clay brick	Inherently non combustible
	Yankee Hill Brick	True clay brick	Inherently non combustible
	Cloud Ceramics	True clay brick	Inherently non combustible
	Summit Brick	True clay brick and "thin brick"	Inherently non combustible
	Sioux City Brick	True clay brick	Inherently non combustible
	Kansas Brick and Tile	True clay brick	Inherently non combustible
	Shaw Brick	True clay brick	Inherently non combustible
IXL		Brick and stone	Inherently non combustible
Mac Metal		Steel siding	Inherently non combustible
GAF	Weatherside	Fiber cement siding	Inherently non combustible
Gentek		Aluminum siding	Inherently non combustible
FastPlank	Woodgrain colors	Aluminum siding	Inherently non combustible
Various Vinyl		Vinyl Siding	Acceptable only when installed over a non-combustible sheathing such as a TypeX gypsum board

Windows and Doors:

Most regions in Canada experience harsh winter conditions and over the years window technologies have improved dramatically as a result of interest in energy efficiency. All windows currently sold in Canada are either double or triple glazed and while there are some frame variants (wood, metal, PVC) the majority are plastic. Many states in the US require that one or both glass panes be tempered glass with the rational that these will withstand either direct flame contact or high radiation loads from close by burning materials. With one exception these are not necessary, as within the limited studies presented in the literature the general consensus is that glazing's might crack under high thermal loads but the likelihood of complete failure is low. The possible exception to this "rule" is when there is a secondary building or structure in close proximity (within limiting distance as defined in the National Building code). In the event that the secondary structure (or neighbor's house) catches fire, the thermal radiation load from this burning structure could be sufficient to result in glazing failure.

Entry doors used in Canada are typically steel skinned and insulated. There are, of course, exceptions but for the most part steel-skinned doors can be considered non-combustible. The same is true of overhead doors for attached parking structures. The likely entry point for embers in this case is the weather stripping on the door – if these are not kept in good condition, it is very likely that wind-blown embers will find their way into the structure.

Soffits or Eaves:

The most common construction for soffits or eaves in Canada is either vented aluminum or vinyl. Vented aluminum soffit has a series of perforations which allow air movement into the attic space and help prevent moisture related problems. Aluminum has a melt point of about 600-650^{o}C and unless there is a fire beneath the soffit (attached decking, plant material) should not be at all stressed from embers. Vinyl soffits, while sometimes rated for flame spread, have a tendency to soften due to the low melt temperature. Softening or failure of vinyl venting, as a result of a thermal load from wildland fire, has been seen numerous times and failure will lead to potential ember entry into the attic space. These materials should not be used in the Wildland-Urban interface unless backed by a non-combustible material. There are non-combustible soffit materials available as indicated below and provision for attic venting must be made so we do not trade one problem for another – increased wildfire resistance but decreased moisture handling capacity.

All soffit/fascia/roof installations should use a drip cap to protect the edge of the roof sheathing from flame contact in the event a gutter is not properly maintained and flammable organic materials build up. There is little evidence to support the notion that an eaves trough full of organic material has sufficient energy to ignite a roof system but the inclusion of a non-combustible barrier is an inexpensive measure and is usually included in any case.

Soffit or Eaves			
Supplier	Model	Material	Listing
Kaycan	SP600V	Aluminum - vented	Inherently non combustible

Allura	Spectrum	fiber cement panels - vented	
Gentek		Aluminum - vented	Inherently non combustible
Peak		Aluminum - vented	Inherently non combustible
James Hardie	HardieSoffit	fiber cement panels - vented and non-vented	
Vicwest		Steel - vented	Inherently non combustible
Domtek		Steel - vented	Inherently non combustible
FormaSteel		Steel - vented	Inherently non combustible

Vents:

There are limited numbers of listed vents in the California qualified product listings and vents (roof or otherwise) available in Canada have little information regarding passage size (or mesh size). The challenge in a Canadian climate is to prevent the entry of embers to an attic space or a crawl space and at the same time encourage air flow to prevent moisture buildup. California and other US states suggest a maximum 3 mm (1/8 inch) mesh covering all openings. Roof mounted vents typically act as an air outlet from an attic space whether fixed, moving (turbine type) or ridge, primarily because of the air flow across a roof creating a low pressure region over most of the roof surface. This, of course, depends strongly on local shielding and adjacent structures and as a result there is no guarantee that roof mounted vents are always going to flow outwards.

Roof vents fall into three general categories: passive, ridge and active. Passive vents include fixed roof surface, gable and under eave vents. Ridge vents are positioned along the ridge of a roof line, in some cases under a cap strip of shingles and active vents are either “turbine” type or powered.

Ventilation		
Roof Surface		
Ventilation Maximum	Various	Static, ridge
Canplas	Duraflo	Static, ridge, turbine
GAF	Master Flow	Static, ridge, turbine
Lomanco	Multiple models for WUI	Static, ridge, turbine
Air Vent	Multiple Models	Static, ridge, turbine
Under Eave		
GAF	Master Flow	under eave strip, mini soffit
	Ember Shield	closable metal vent
Air Vent	Various	aluminum strip, under eave, vented drip edge
Foundation		
GAF	Master Flow	

Given that the literature on most vents is not aimed at preventing ember entry but more to prevent rodent/insect entry the acceptable models will have to be examined on a case by case basis. Two companies, Lomanco and GAF, have recognized the WUI and the problems of ember transport and have designed vent systems to address this.

For the remainder the restriction on opening size less than 3 mm (1/8”) should apply unless there is a good reason for using larger openings. What is meant by this is that with some vents there is quite a circuitous path from outside to attic space and this may well be enough to prevent ember entry. However, without some rational reason or relevant test data this is simply speculation and the maximum opening size restriction should be adhered to.

Decking:

Decks and other attached structures have been blamed for numerous structure fire starts during wildfire events. In the California qualified products listings there are more decking materials than all other categories combined. In general, there are two issues: the material the deck is constructed with and the treatment of the area around/under the deck.

Few of the listed materials in the California qualified product list are classified as non-flammable. Most are rated either through a test method developed for California (SFM 12-7A-4A) or as a flame spread classification from ASTM E84. That being said there can be a wide variety of flame spread ratings that are still deemed acceptable for use and the California method is not without criticism. Wood decks are included in the California qualified products list only as hardwoods, redwood or cedar – there do not appear to be any softwood lumber species listed.

The list that follows should give a general idea of the types of materials that could be considered acceptable. In some cases the products are shown as part of a system and in those cases deviation from the manufacturers installation instructions would void any claim of greater fire resistance.

Decking Products			
Company	Product	Material	Rating
Timbertech	Azek - Vintage	Composite	Class A
	Azek - Harvest	Composite	Class B
	Edge	Composite, scalloped	Class B
	Pro	Composite	Class C
Deckorators (listed as Fiberon Composites LLC)			
Fiberon	Promenade	PVC	Class A
	Paramount	PVC	SFM 12-7A-4A
	Concordia	Composite	Web site claim ok but no listing in California data base
	Sanctuary	Composite	SFM 12-7A-4A
	Good Life	Composite	SFM 12-7A-4A
	ArmorGuard	Composite	Not listed due to board profile
Moisture Shield	Vision		California Listing SFM 12-7A-4A
	Meridian		California Listing SFM 12-7A-4A
	Vantage		None
Trex	Select	Composite	California Listing SFM 12-7A-4A
	Transcend	Composite	California Listing SFM 12-7A-4A

Craft Bilt		Aluminum	Inherently Flame Resistant
Mondi Aluminum		Aluminum	Inherently Flame Resistant
Outdoor Kulture	Alumi-deck	Aluminum	Inherently Flame Resistant
Tanzite		cultured stone	should be flame resistant - requested test results Sept 3, 2022
Duradek	PVC film over polyester fabric	When installed as tested only	Class A when installed over plywood and cement board
			Class C when installed over plywood alone
Tufdek		When installed as tested only	Class A when installed over plywood and cement board
			Class C when installed over 1x8 nominal lumber

In all cases it has been assumed that the decking would be installed over a pressure treated structural frame but it should be noted that in all California SFM 12-7A-4A evaluations the decking was installed over a fir structure – not common in Canada and no information could be found on the performance of treated softwood vs fir. Flame spread measurements of various wood types (fir 69 vs spruce 65-100 depending on species) [1] would indicate that these species are similar and so the fire test results can be considered valid.

Deck Skirting:

Keeping the underside of a deck debris free is paramount to ensuring that the deck does not become the starting point for a structure fire. Two options exist for this – removal of all organic material that might accumulate or skirting the deck to ensure that flammable materials cannot accumulate. The second method, skirting, would also ensure that embers, either from a wildfire or nearby burning structure, could not get under the deck in the first place. Skirting is not common in Canada as the underside of the deck may be used for storage (if the space is tall enough) or there may be no treatment at all if the deck is near the ground. Most current skirting is intended for esthetic purposes – creation of a storage space that still visually appealing. Thus, the most common deck skirting, wood lattice, does little to prevent the accumulation of organic debris and indeed may create an increased fire hazard due to the materials and small cross section of members (essentially kindling).

Fences:

Recent studies of large-scale disasters have pointed to combustible fencing materials, attached to a structure, as a likely pathway to structure ignition where building separation distances would not predict structure to structure ignition. The current thoughts are that the use of combustible materials (wood,

lattice) combined with the build-up of organic materials and the natural propensity of a wind barrier to accumulate embers in its wake results in significant fire, starting at the base of the fence, and carrying along the fence to the attached structure. Currently most fences are constructed with wood but there are alternatives that are less flammable and retain the aesthetics that are desired (as opposed to open chain link type metal fencing). It is not necessary that the entire fence be non-combustible to help protect the structure but only the portion (1-2m) that is directly attached to the building. The list below is a very limited selection of available, less flammable, materials and serves only to illustrate that there are alternatives to traditional wood fencing.

Fence Products – Non wood			
Company	Product	Material	Rating
Trex	Seclusions	Composite	Class B flame spread
Stackwall	Various configurations	Concrete	Inherently non combustible
Modinex	Lattice Panels	Composite (wood, poly)	No rating info
Peak Products	Fencing	Aluminum, steel, chain link	Inherently non combustible
Northwest Aluminum	Various configurations	Aluminum, chain link	Inherently non combustible

References

1. Canadian Wood Council, “Fire Safety Design in Buildings”, 1996