Building Better Homes in Wildfire Country

Wildfires are unpredictable and no building is 100% safe, but there are ways to design your house and landscape to provide more time for occupants to safely evacuate in an emergency situation.

Wildfires are growing in severity and in number. Nowhere is that more true than the state of California, where the number of acres burned has often spiked close to 10 million per year over the past two decades. In 2020 alone, several enormous blazes burned millions of acres and destroyed thousands of structures. The August Complex fire, which raged between August 16 and November 12, was the largest wildfire complex in California history, claiming more than one million acres and destroying more than 900 structures. The Santiam Fire, which was initially three separate fires, burned over 400,000 acres between September and December, destroying more than 1500 total structures. And the North Complex, which was the sixth-largest fire complex in the state's history, burned more than 300,000 acres and destroyed over 2300 structures.[1]

The need is clear: Homes in wildfire-prone areas must be built to a higher standard of fire resilience to increase the odds of preserving structures and to provide occupants additional time to find safety. However, the methods to get there can be a bit unclear. Often, the focus is placed on materials alone, with the thought that if noncombustible outer materials are selected, the rest of the home is protected. However, fire protection is much more complicated than that.

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[1]via https://inciweb.nwcg.gov/

WHAT'S THE DIFFERENCE?

Combustible, noncombustible, ignition resistant, fire resistant

In any discussion about best building practices to withstand wildfires, several terms will come up. On the surface, some of these words sound interchangeable—but each has a different definition. Understanding the differences between them is critical when designing and building the most fire-safe home possible.

Combustible
Combustible building materials include those that ignite and burn easily. Often, these materials will also release flammable gases as they burn—quite literally adding fuel to the fire. Wood, wood composites, and plastics are examples of combustible materials. Improving a home's fire-survival odds means careful consideration of the use of combustibles on the home's exterior.

Noncombustible
Noncombustible building materials include stone wool, brick, concrete, most types of metal, and glass—in other words, materials not known to ignite, burn, or release combustible gases. To be classed as noncombustible, these materials must meet certain ASTM (American Standards for Testing Materials) testing criteria under specified conditions. They're usually the best option for creating a fire-safe exterior.

Ignition resistant
Ignition-resistant materials are not necessarily inherently noncombustible—and some materials have been known to become less ignition resistant over time as they decay due to natural weathering effects. That's why building materials must meet several standards. First, by the rate at which flames spread once the material does ignite. Second, to simulate decay over time, materials are subjected to accelerated weatherization so they can be tested for consistent ignition resistance. Stone wool insulation, asphalt shingles, and treated lumber are three commonly found examples of ignition-resistant building materials.

Fire resistant
"Fire resistant" is an adjective often applied to products with properties that resist burning, but it has no standard measure; "Fire Resistance Ratings," by contrast, are official classifications given to assemblies built to withstand and contain fire for a certain amount of time while maintaining structural integrity. For example, many exterior doors feature a fire-resistance rating of 20, 45, 60, or 90 minutes. This represents the amount of time that the door can withstand a blaze so that occupants have a chance to escape.

ROCKWOOL®, offers some insights: "When it comes to walls, floors, and roofs, the concept of fire resistance addresses a number of aspects. One is to slow down the passage of fire from one compartment to another, while maintaining its structural integrity throughout the process."

Although selecting materials with fire resistance is an important design consideration, achieving overall fire resilience in Wildland-Urban Interface (WUI) areas requires first understanding how it is that homes catch fire. Then, it is important to look at materials to determine whether they're combustible or noncombustible, whether they're ignition resistant or fire resistant, and whether they have low or high flame-propagation rates. Then the next step is a challenging one: taking this information into account while designing fire-resistant assemblies for the roof, walls, and other portions of the structure.

Best building practices for wildfire survival

Building the most fire-safe home possible requires a holistic approach to enclosure design. It's not enough to use noncombustible siding if the insulation beneath easily ignites when subjected to radiant heat from a nearby burning building or landscape.

"Fire resistance is one thing," Roos says, "But there is also flame propagation. Those both have to be addressed if you're going to be responsible about your construction."

Flame propagation, related to the concept of *flame-spread rating,* is a measure of how far flames spread over a material once it has ignited. Materials with lower flame-propagation rates will offer better fire safety than those with higher rates. Ideally, building assemblies should be designed with materials that offer high fire resistance and low flame-propagation rates, while the assemblies should also minimize threats like gaps or voids where blowing embers can lodge to start a fire.

For manufacturers such as ROCKWOOL, responsible construction is an important factor in how products are designed. Insulation can do more than provide better energy efficiency and sound absorption. ROCKWOOL insulation is made out of stone wool, a byproduct of volcanic rock. Stone wool, a type of mineral wool, can withstand heat up to 2150°F (1177°C), meaning in homes that catch fire, flames won't be able to spread as quickly, giving occupants more time to escape safely.

How houses catch fire

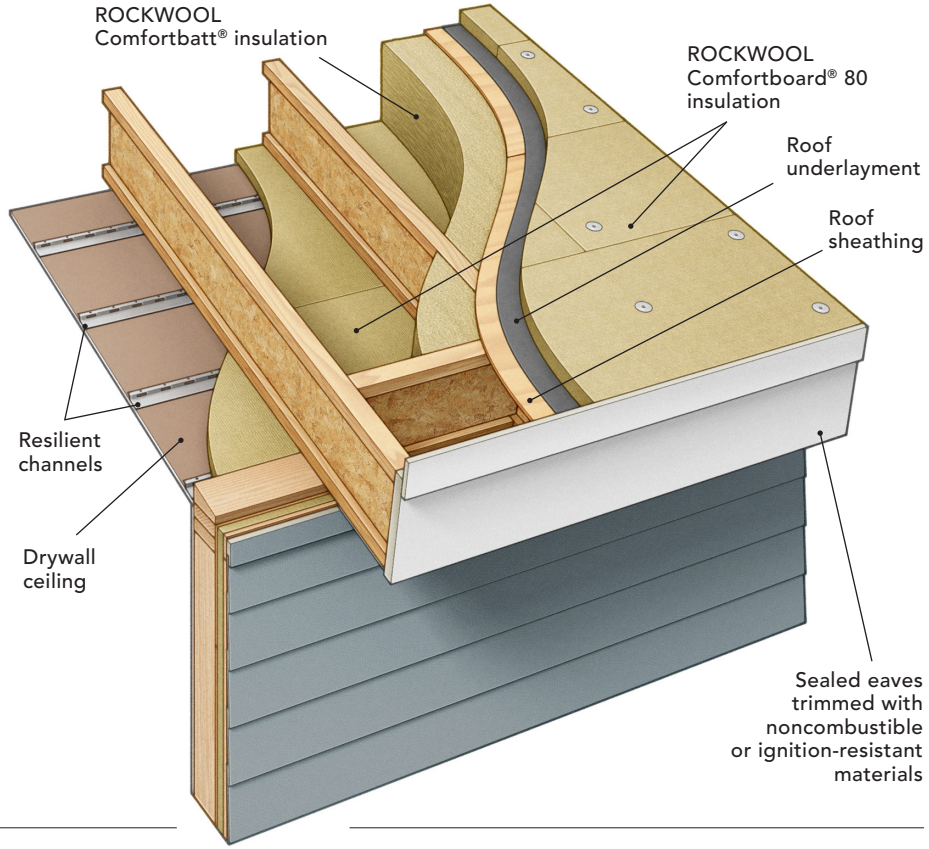
Defending homes against wildfires—or any type of fire—starts with considering each of the three ways that a home can catch fire. "The most challenging aspect of wildfires is that they're a changing beast," Roos says. "There are a few different mechanisms that can drive ignition in the built environment." Fires can be caused by sparks or burning

A FIRE-RESISTANT ROOF

Building a better roofing assembly is key to creating a more fire-resistant enclosure. This means considering not just the surface product, but also the underlayment, sheathing, insulation, joists, and other components that go into a roof. ASTM E108 Class A–rated surfaces like clay, concrete, slate, and many types of asphalt or metal are a great start, but builders should not forget to consider components beneath the surface material.

Noncombustible roof boards can improve the roof assembly's fire resistance, for example. There are noncombustible options available from manufacturers like ROCKWOOL. These include ROCKWOOL Comfortboard® 80 and 110 (in residential applications only), ROCKWOOL Multifix™, and ROCKWOOL Toprock® DD. Each is rated as a noncombustible material with a flame-spread index of 0 and a smoke-developed index of 0, which can improve a roof assembly's ability to withstand conditions during a wildfire.

There are other measures to take when creating a fire-resistant roof assembly. Eaves should be sealed, and valleys should be covered by an ASTM E108 Class A material to prevent embers from igniting the roof. Vents should be covered with ⅛-in. mesh to prevent burning embers from getting into the house. It's also important to use ignition-resistant or noncombustible materials like metal and fiber cement for the soffit and fascia to further protect the eaves.



embers blown by the wind, radiant heat from nearby buildings or objects, or direct contact with flames.

Of these three threats, embers are the most commonly seen to cause damage, responsible for an estimated 70% to 90% of homes lost to wildfires. This is because embers can blow up to a mile away from advancing flames—and the average home has plenty of nooks and crevices, such as eaves and soffits, in which to catch these embers, where they will smolder until the surrounding material catches fire.

Radiant heat is another major threat when there are buildings or objects nearby that can ignite. If a neighboring home catches fire, the heat from the blaze can shatter windows and set combustible materials outside and inside the home alight.

When homes catch fire due to contact with spreading flames, the culprit is often vegetation and other landscaping choices around the house. Flames can ignite trees near a home or spread through dry grass and garden beds, igniting siding or other flammable building materials in its path. As an example, wood mulch is a popular landscaping choice, often against exterior walls. But in areas at high risk of wildfire, wood mulch would not be the right choice because it is both combustible and can act as a trap for combustible debris, making it more likely for fire to spread and catch on to the walls of the home.

What do building codes have to say?

Building codes outline the basic requirements a home must meet to be up to code, such as the types of materials that can be used, the assemblies that are preferred, and the minimum ASTM criteria that materials must meet. In practice, many provisions in the building codes aim to prevent the intrusion of burning embers into or under structures where they can ignite combustible materials. State and local authorities may also implement further code requirements such as fire-rated exterior doors, dual-glazed windows, landscaping specifications, or materials like noncombustible or fire-resistant wall coverings.

For example, in California, where wildfires are common and can be quite devastating, fire codes stipulate that flammable vegetation must be removed within 30 ft. of buildings, and vegetation within 100 ft. of a building must be modified to create a "defensible space" firefighters can use to fight a fire.

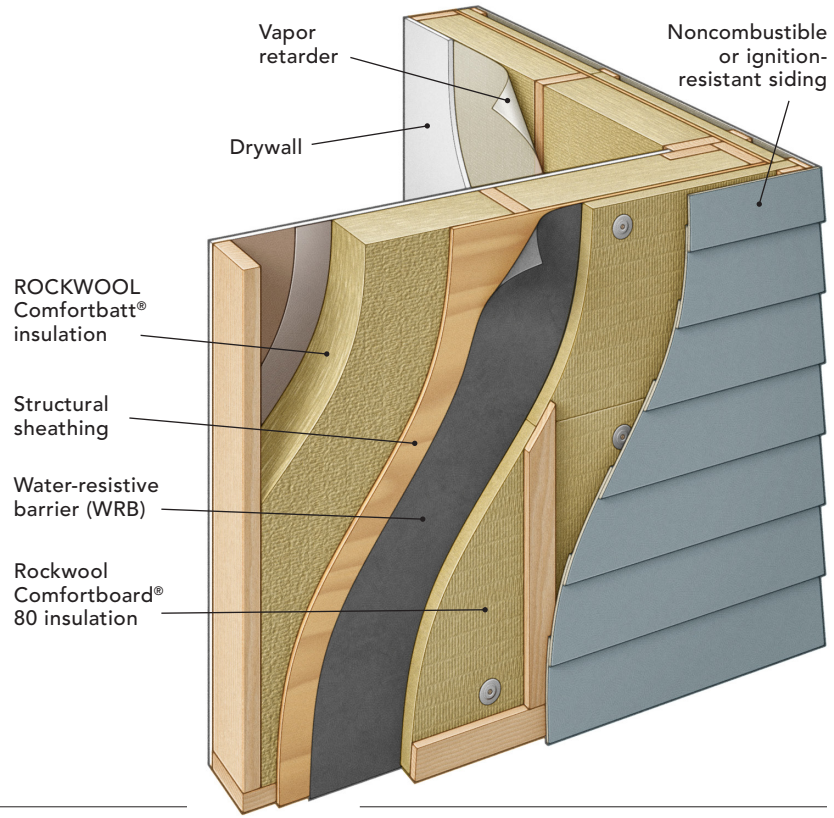
Because California is so prone to wildfires, it stands as an example of fire codes made to help combat the damages. Building a house in California means first consulting a set

A FIRE-RESISTANT WALL

As with the roof assembly, what's important in exterior-wall construction is the combination of materials. "Vinyl siding doesn't provide a lot of protection," Roos says. "But it actually isn't the problem. Vinyl typically doesn't burn. It tends to melt and fall away from the structure. It's the materials behind the vinyl siding that can either make or break the system."

While noncombustible or ignition-resistant materials like fiber cement, stucco, plaster, brick, and stone are preferred siding, it is possible to comply with the California Building Code's Chapter 7A—which stipulates materials and construction methods for wildfire exposure—even when using a product such as vinyl siding. This means complying with the State Fire Marshal Standard SFM 127A-1, now adopted into ASTM as E2707, which tests the ability of the wall assembly to resist the penetration of flames into the stud cavity.

One way to do this is with exterior stone wool insulation like ROCKWOOL Comfortboard 80 and ROCKWOOL Comfortbatt®. This approach not only increases fire resistance but mitigates thermal bridging for a more efficient wall assembly, thereby meeting California's progressing energy-conservation requirements. In this example, this wood-framed assembly has been rated by Intertek with a 1-hour fire-resistance rating due to its incorporation of stone wool products from ROCKWOOL. Here, Comfortboard 80 is fastened with structural screws on top of the water-resistive barrier, insulating and providing enhanced fire resistance to the exterior of the wall, while Comfortbatt is friction-fit in the interior cavities of the framing. While dynamics are different between fiber-cement and vinyl siding as vinyl doesn't provide any protection, the lesson is the same–it's what's behind the cladding that will make or break your assembly.



of maps to determine whether the home site is in a fire hazard severity zone—and if so, which zone the home site is in. Classifications range between moderate, high, and very high fire hazard severity zones.

If the home site is in a fire hazard severity zone, then specific construction guidelines apply. These are designed to minimize the chance that the house burns in the many wildfires that sweep the state each year. These rules are part of the California Building Code, and they're listed in WUI code that addresses fire-prone areas. Among them are provisions for everything from roof coverings and window glass to vent openings on eaves and cornices—plus landscape practices designed to help keep combustible vegetation at a safe distance from buildings.

The California State Fire Marshal also maintains a building-material listing service that lists products that the California Department of Forestry and Fire Protection (Cal Fire) has verified as being WUI-zone compliant. ROCKWOOL Comfortboard 80, Comfortboard 110, Toprock DD, and Multifix are among the products listed here.

But can codes do more? The problem with the WUI Code is that, while relatively effective at protecting buildings from fire, it isn't universal. "Construction takes place in many areas that could be considered a wildland-urban interface area," Roos says. "But those jurisdictions have not necessarily adopted the WUI Code; Chapter 7A in the California Building Code." The adoption of these provisions is largely enacted by local authorities such as the fire district or building department, so while one town may have strict WUI Codes, the neighboring community may not, depending on the calculated risk factor deemed by officials.

Examples of this can be seen in the October 2017 Wine Country or North Bay fires in Northern California, which burned more than 210,000 acres and destroyed more than 8000 structures. While Cal Fire and the California Department of Forestry were analyzing the details on these fires, the Thomas Fire in Southern California struck, burning more than 270,000 acres during a time that was considered well outside the normal fire season in California. The irony was that many of the structures that burned in these blazes—such as the 2800 structures that were destroyed in Santa Rosa—weren't in areas deemed high risk.

These concerns raised question about the effectiveness of codes currently in place. Do

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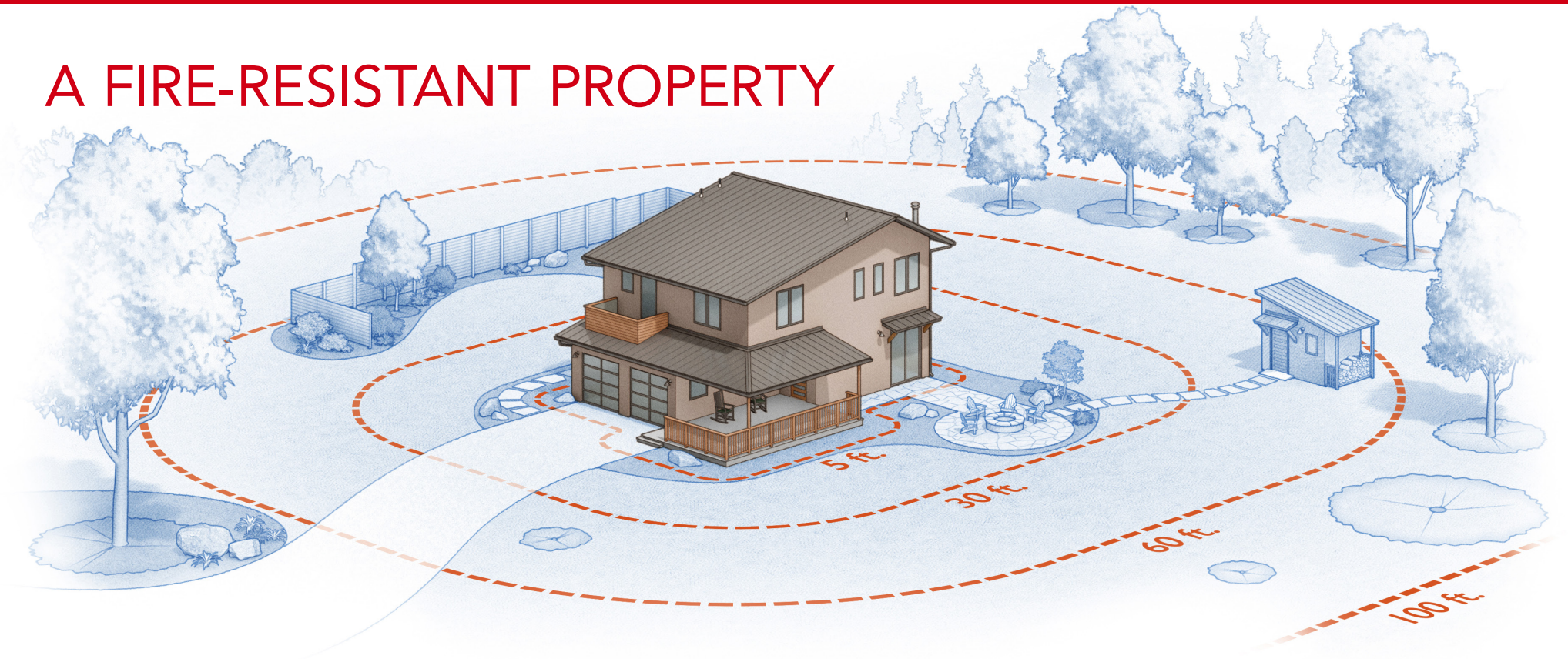
A FIRE-RESISTANT PROPERTY



WINDOWS

For optimal fire resistance, windows and all other glazing should be fire rated or feature multiple panes with at least one layer of tempered glass.

DOORS

Doors should be fire rated.

DECKS

Decks can use wood frames, but they should be finished with a fire-resistant material that extends to within 6 in. of the ground. Cantilevers and other overhangs should be constructed and finished with noncombustible materials. It's also good practice to ensure that combustible materials are not stored underneath decks.

OUTBUILDINGS

Codes may allow outbuildings, fences, and other outdoor structures to be built with any material, but it is smart to build these things using noncombustible materials wherever possible. They should also be kept at least 30 ft. away from the house (this distance will vary regionally by code) so that flames don't spread should they ignite.

LANDSCAPE DESIGN

Homes should have a noncombustible area within 5 ft. of the home's perimeter. This means no structures or combustible vegetation against the home that could ignite and spread flames to the home itself. This includes wood mulch. "There have been cases where fatal fires, even in non-WUI areas, have been caused because of combustible mulch next to a combustible wall," Roos says. Gravel, brick, concrete, and stone are good options for noncombustible landscape features that can be used around the home's perimeter.

Trees should be spaced so as to not spread fire to each other or to the home, and at least 10 ft. away from the home. Within 10 ft. to 30 ft. of the home, trees should be spaced 18 ft. apart. Between 30 ft. and 60 ft. of the home, trees can be spaced 12 ft. apart; and between 60 ft. and 100 ft. of the home, trees can be spaced 6 ft. apart.

Fuel breaks can and should be included as landscape features. This includes noncombustible details like concrete driveways, sidewalks, patios, and dry streams, each of which can help prevent the spread of flames.

MAINTENANCE

Maintenance is another important part of fire prevention. Keep gutters and roofs clear of combustible debris, and mow lawns to below 4 in. Be sure to keep vegetation around outbuildings, decks, propane tanks, and other outdoor fixtures trimmed. Remove sprouts and saplings growing beneath mature trees, prune mature trees away from the ground, and remove any dead vegetation beneath them.

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hazard zones need to be expanded? Should some areas be classed as too risky for development? What about retrofitting homes built before WUI codes were enacted? These are all things officials are pondering—but in the meantime, there are clear options for builders to construct a more fire-resistant home.

What about retrofits?

What about existing homes? In some areas, it's not the new homes that are most threatened, but those built before codes were enacted or strengthened in their neighborhood. "Building codes address new construction," Roos says, "And fire codes address existing buildings and then the operation of those buildings. For example, fire services will routinely inspect to make sure that you're in compliance on an ongoing basis with the fire codes. Fire provisions within building codes are related to new construction."

This causes difficulties for regulators. For example, if a home has a wood-shake roof, it's challenging for regulators to ask for a retrofit. Homeowners may not have the resources or inclination to replace the roof with something that has better fire resistance. Insurance companies may become a more powerful driving force by asking homeowners to make fire-resistant upgrades in order to maintain coverage, but for now, the onus is on homeowners to make upgrades themselves—and on builders to recommend products and assemblies that can increase a home's overall fire resistance.

In conclusion

Creating homes with better odds of withstanding wildfires is a challenge, but one that is certainly possible. Doing so doesn't necessarily mean following local building codes or even the WUI Code, but rather, going beyond these codes. Choosing materials classified as noncombustible, ignition resistant, or fire resistant will take you part of the way there, but it's important to take a holistic approach to the assemblies that make up a home. Consider carefully the materials that go into each assembly and how those materials add or subtract from the fire resistance of the assembly as a whole—and pay careful attention to all the details like vents or other voids that can catch the smoldering embers that so often claim homes during wildfire events. Those are the keys to building homes in wildfire country.