Photo: Colorado Springs Fire Department

Living With Wildfire

Builders learn the lessons of life on the edge of the wilderness

BY TED CUSHMAN

When the Waldo Canyon wildfire roared into Colorado Springs in 2012, destroying a record 346 dwellings in a matter of hours, it was a disaster. But it wasn't exactly a surprise—at least, not to Colorado Springs Fire Marshal Brett Lacey.

Colorado Springs, Lacey told *JLC* in a conversation last month, has a long history with wildfire. In 1950, a fire that started in a slash pile created during construction of a golf course got out of control, killing 10 firefighters. In 2002, the so-called Hayman Fire, which burned for three weeks and destroyed 133 homes, "made a 19-mile run in one day," said Lacey. "It never hit the City of Colorado Springs, but it was hugely visible from the city, and ash was dropping down all over town."

After the Hayman Fire, Colorado Springs banned wood-shake roofs for new homes and re-roofs. And immediately after the Waldo Canyon fire, Lacey convened a task force including builders and homeowners to craft "Appendix K," an amendment to the city's fire code that required "Firewise" vegetation management techniques, as well as a number of fire-resistant construction details, for rebuilding in the city's Hillside Overlay zone (a previously existing zone that encompasses much of the burn area).

But then, just a year later, wildfire struck again: The so-called

Black Forest fire burned another 500 structures in wooded country just outside the city—a new record, but one that Lacey said won't stand. "I have a whole other section of town that is going to burn one day," Lacey said, "and we are going to suffer big losses, because they are older homes from the 1950s and 1940s, with heavy vegetation. It will be much less severe because of our mitigation efforts and because of the awareness, but we are still going to get hit pretty hard."

When that happens, said Lacey, the new Appendix K requirements will govern the rebuilding—just as they do today in the fire-ravaged neighborhood known as Mountain Shadows (now almost completely rebuilt), where the Waldo Canyon fire did its worst damage. In the meantime, the fire service is working with owners of existing homes throughout the vulnerable parts of town to tackle the risks created by underbrush and trees—or, as firefighters call them, "fuel."

HOW HOMES CATCH FIRE

Regular house fires have a few well-known typical causes. Cooking equipment started 46% of ordinary house fires between 2010 and 2015, according to National Fire Protection Association (NFPA) statistics; heating equipment started 16%, wiring and lighting started 9%, arson caused 8%, and smoking caused 5%.

Similarly, when wildfires set fire to homes, there are a few well-known ignition pathways. In the Waldo Canyon fire, according to Colorado Springs Fire Department investigators, 54% of structure ignitions were caused by windblown firebrands and embers. "Vegetation exposure"—that is, burning trees and brush near buildings—caused 22%. "Structural exposure"—that is, house-to-house fire transmission—caused 16%. Only 8% of the house fires were directly caused by the wildfire flame front itself.

Experts have seen a similar pattern in previous wildfires around the country. Typically, windblown embers—which can fly for a mile or more in a high wind—are the biggest danger to homes. Sometimes the embers land on a roof or collect in a gutter or valley, setting fire to accumulated leaves or pine needles. Sometimes they pile up at the base of a house wall, then ignite siding or the exposed bottom edge of sheathing. Sometimes, heat from burning trees or neighboring houses shatters windows, and embers blow into the house and set furniture or curtains on fire. And very typically, embers get sucked into soffit or gable-end roof vents, igniting the attic and burning the home from the top down.

While forest fires can produce a lot of flying embers, a house on fire actually produces far more, and for a longer period of time. In a conflagration like the Waldo Canyon fire in Mountain Shadows, every house that catches fire multiplies the risk to its neighbors. Conversely, every house that successfully resists ignition reduces the risk to other houses—not just next door, but for miles around. The measures put in place in Colorado Springs after the Waldo Canyon fire aim to ratchet down the domino effect so typical of major conflagrations, as fire departments run out of manpower and multiple structure fires begin to spread unchecked. The idea is to create not just resilient homes, but resilient neighborhoods—and to give firefighters a fighting chance at success.

New housing developments in the Colorado Springs wildland-urban interface (WUI) zone must feature "defensible space"—with sparse, pruned vegetation—to prevent the rapid spread of fire. In existing neighborhoods, the fire service is advising homeowners to maintain their properties in a similar way. Top, an arborist with Front Range Arborists clears an overhanging birch tree away from an older house. Bottom, arborist Jason Sharp educates a property owner about her choices.

Photos: Colorado Springs Fire Department

Appropriate pruning and thinning of trees and shrubs near a home helps firefighters suppress fire as the wildfire front approaches the structure. Above, a Colorado Springs firefighter successfully defends a house during the 2013 Black Forest fire, which destroyed more than 500 homes. The truck and crew worked for hours at this location, carefully rationing their limited water supply, but saving the home as the flames crept along the ground through the area.

Photo: Colorado Springs Fire Department

CREATING DEFENSIBLE SPACE

The Colorado Springs fire code's new Appendix K resembles other well-known standards for homes in wildfire country, such as the International Code Council's Wildland-Urban Interface Code, the National Fire Protection Association's NFPA 1142 (Reducing Structure Ignition Hazards from Wildland Fire), and Chapter 7a of California's state building code ("Materials and Construction Methods for Exterior Wildfire Exposure"). All those documents implement a two-pronged approach to reducing the risk of home ignition: They call for ignition-resistant building details for the house itself, along with measures to control natural fire hazards on the landscape surrounding the home.

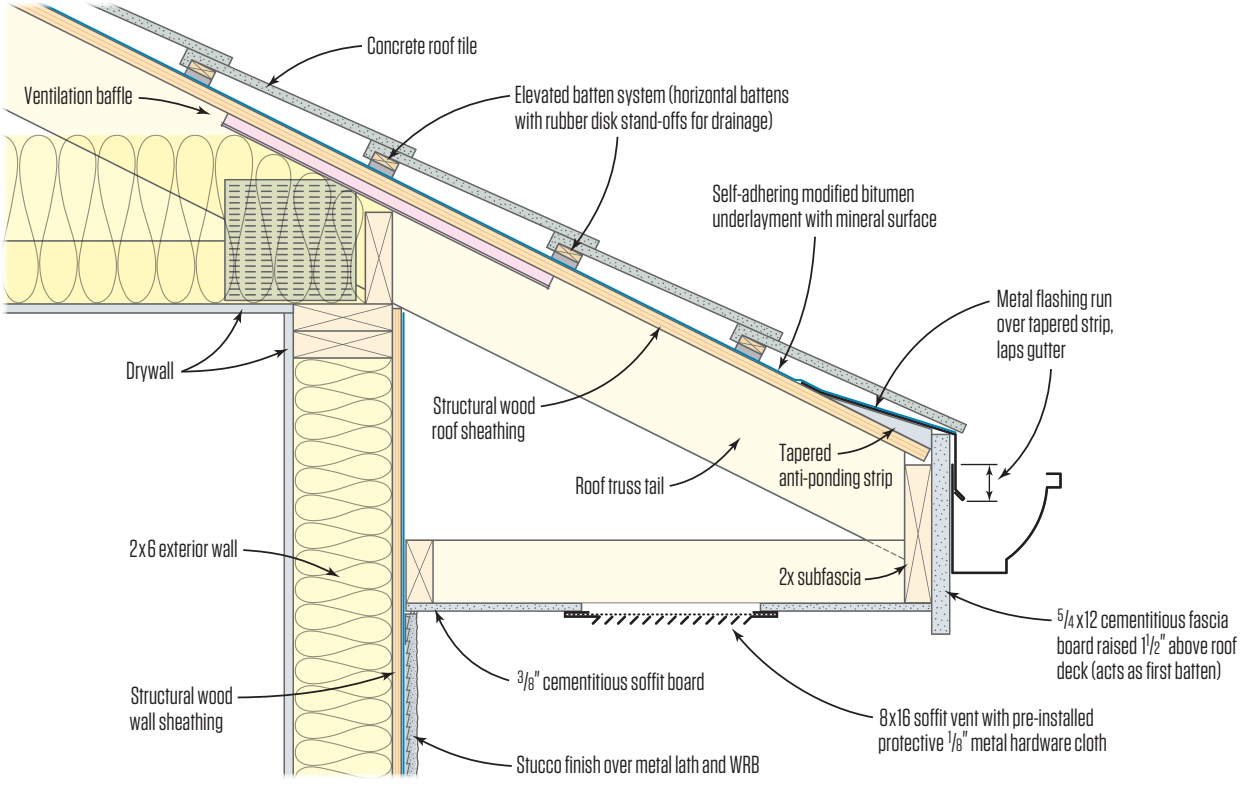
Appendix K defines a "safety zone" of 30 feet around each home, where fire-prone local shrub and tree species are allowed only in small "patches or clusters," separated by mown grass or noncombustible materials such as gravel. Trees and shrubs aren't allowed at all within 15 feet of the house. Some large trees are allowed, but branches have to be trimmed back, away from roofs. These rules reflect the "lean and green" principle: Vegetation is kept thinned and pruned, and "ladder fuels" such as dead lower limbs that could let a ground fire climb up to the crown of a wooded area are removed.

This kind of "fuels management," as experts call the technique, creates "defensible space" around the house where firefighters can safely deploy to defend the building as a fire approaches. And with luck, thinning the landscape this way could even protect some homes from burning in a wildfire even if no firefighters were available to help.

The 30-foot radius of the safety zone (often called the "Home Ignition Zone") is based on research indicating that 30 feet is a safe distance between the wood wall of a house and the radiant heat of large flames. But the 30-foot number may not suit every situation, according to a National Institute of Science and Technology (NIST) analysis of the Waldo Canyon fire. If homes are burning close by, or if there's heavy vegetation on fire in steeply sloping terrain, 30 feet might not be enough distance to keep another building from catching fire—or to allow enough space for firefighters to safely operate.

Also, big forest fires on windy days can shower a home with hot embers even if flames never approach the house—especially if the fires also involve multiple wood-framed buildings. So an effective

Ignition-Resistant Roof Edge Detail



In a big wildfire, strong winds may carry hot embers or even large flaming firebrands for long distances. Embers can be sucked into soffit vents or land in gutters, where accumulated pine needles or leaves may catch fire. The detail above reduces these risks; the soffit and fascia are noncombustible fiber cement, the roof is concrete tile, and metal roof flashing laps down into the metal gutter. The rough bottom surface of the tile allows moisture to weep out, but restricts the entry of flame and embers.

strategy against major wildfires has to include measures to protect the buildings themselves against ignition.

IGNITION-RESISTANT BUILDINGS

From the roof down, Appendix K, like other wildland-urban interface codes, specifies materials and assemblies that will reduce the odds of a building catching fire when exposed to the typical conditions created by a wildfire.

Roofs. Appendix K requires Class A roof systems. The Class A rating is based on laboratory testing of roof assemblies, in which a large criss-cross lattice of burning wood is placed on the roof covering and allowed to burn out. The material passes if the sheathing is not ignited. Clay tile, concrete tile, slate, and metal roofing typically comply, as do most fiberglass asphalt shingles.

Attic vents. Roof vents have to be screened with wire mesh or hardware cloth, with openings no larger than 1/8 inch. The 1/8-inch opening size is typical of all the well-known wildland-urban interface codes. According to wildfire expert Stephen Quarles, who helped craft California's wildfire code before joining the Insurance Institute for Business and Home Safety (IBHS), an industry think tank, 1/8 inch is a compromise. While the mesh may let small sparks through, it will hold out the bigger embers that carry the most heat. At the same time, the holes are big enough that they're less likely than finer mesh to become plugged with paint or dirt over many years in service.

Eaves and soffits. Soffits and fascia should be built with ignition-resistant material such as fiber cement or metal. Decorative features like false rafter tails are allowed to be made of wood or other combustible materials, but the fire service strongly urges builders to choose ignition-resistant options whenever possible.

Illustration by Tim Healey

Photos: Stauffer and Sons Inc.

Colorado Springs builder Andy Stauffer installs a screened vent in the soffit of a home near the city (top), then places an outlet vent in the home's roof (middle). At the roof edge (bottom), metal drip edge will extend down into the gutter.

Gutters. The big risk posed by gutters isn't the gutters themselves, but the flammable materials, such as leaves and pine needles, that accumulate in them and that can readily catch fire when windblown embers land there. When that happens, vinyl gutters typically melt and fall off, posing a risk of ignition at the base of the house. Metal gutters stay in place, which allows burning debris to ignite the exposed edges of roof sheathing.

Appendix K doesn't require debris screens over gutters, but the fire service cautions homeowners that gutters should be kept clear of combustible materials. Appendix K does require roof sheathing and framing to be protected against ignition by metal flashing at the roof's edge that extends down into the gutter. In the case of vinyl gutters, the rule requires noncombustible ground covering, such as stone, at the base of the wall where flaming gutters might fall.

Cladding and siding. Exterior cladding in the wildfire-prone area must be ignition-resistant. Approved materials include fiber cement, stucco, masonry, and manufactured stone. Natural wood, hardboard, and vinyl are prohibited.

Overhangs and projections. The exposed undersides of building projections such as bay windows are vulnerable to ignition from burning vegetation or accumulating embers. Appendix K requires these surfaces to be protected with the same type of material that is approved for wall cladding.

Exterior doors. Appendix K requires doors to be noncombustible or, if wood, to have solid cores at least 1 3/4 inches thick. Any glass in the door must be either tempered safety glass or multilayered glazing, with one exception: Front entry doors are allowed to incorporate decorative single-pane glass.

Windows. Windows must be dual-pane. Research has shown that dual-glazed windows can survive intense radiant heat in a wildfire (typically, outer panes crack and break while inner panes survive). Tempered glass has proven to be the best performer in practice, as well as in laboratory testing. Wildfire expert Steven Quarles points out that even before wildfire codes began to take effect, code has required tempered glass for certain windows, such as windows close to the floor or next to stairs. So most window companies have had no difficulty making dual-glazed tempered options available where needed to make a home ignition-resistant.

Decks. Brush and trees near a deck can readily set it on fire, as can combustible material such as firewood stored under a deck. Windblown embers can also ignite a deck, but in the Waldo Canyon fire and other fires, composite decking proved less likely to ignite than wood decking, which tends to split and crack and catch hot embers. Appendix K requires ignition-resistant or noncombustible material for decking, but allows wood framing for the deck structure.

Base of walls. Embers piling up against a house can set the exposed bottom edge of wall sheathing on fire, even if the cladding is noncombustible. Appendix K requires wall bases to be protected with fire caulking (or 1/8-inch wire hardware cloth, if weep holes are needed). Full-scale laboratory research at IBHS has shown that a 6-inch separation between combustible siding and the ground is enough clearance to sharply reduce the risk of fire from embers at the base of the wall.

Colorado Springs builder Andy Stauffer rebuilt almost two dozen houses after the wildfires in the Mountain Shadows and Black Forest communities. Above are two examples. Both homes have cultured stone and fiber-cement cladding systems and are set in sparsely planted landscapes with stone mulch. The top example's raised deck is framed with treated wood and decked with composite decking; the lower home has a concrete patio.

THE INDUSTRY ADJUSTS

The 2012 Waldo Canyon fire set off a minor building boom in Colorado Springs. Local builder Andy Stauffer (staufferandsons.com) rebuilt 11 houses there after that fire, and 10 after the Black Forest fire. But post-fire building code changes haven't affected Stauffer's methods much, if at all.

"What I could build after the fire is about what I was building before the fire," Stauffer told *JLC*. Virtually every house still gets a synthetic stone and stucco exterior, with fiber cement for lap siding details, soffits, and fascia. Durability and maintenance concerns motivate that choice, said Stauffer: "Clients say, 'Am I going to be up on a ladder painting this in five years?'"

By the same token, Class A fiberglass shingle roofs stand up better than wood shakes to Colorado's legendary hailstorms; better yet is concrete tile, which is easier to repair as well as more durable. And in the wake of the fire, said Stauffer, local lumberyards quickly began to stock soffit and roof vents with pre-installed protective metal hardware cloth.

"It was a combination of the clients wanting low maintenance, and the fire departments making reasonable suggestions that the market just picked right up on," said Stauffer. "People had their own reasons to do what the fire department was asking."

In 2013, when fire approached the Black Forest neighborhood where Stauffer lives, "we had to bug out," he said. "And we were sure we were going to lose our house." But a change in the wind spared Stauffer's house, "which was good," he said, "because from experience, I knew I would be working hard rebuilding other people's houses."

Ted Cushman is a senior editor at JLC.

Photos: Stauffer and Sons Inc.