NICHIHA
fiber cement

Elevating Southwestern Stucco Designs with Fire-Resilient Fiber Cement

SEPTEMBER 2018

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01 The Sea of Stucco

From the Pueblo Revival style inspired by the architecture of indigenous Puebloan peoples to the Spanish Colonial architectural styles that adapted elements of European approaches including Baroque, Gothic, Mudéjar and Neoclassicism, Southwestern architecture is a hybrid, born of disparate cultures.

Popular media propagates stock images of Southwestern styles, from the residential vernacular to modern commercial designs, set against a landscape of singular beauty. Individuals who have never set foot in the region have notions of flat-roofed adobe dwellings situated in a desert distinguished by red rock formations and cacti.

Long before the average person could access the curated daily lives of celebrities through social media, we imagined stars strolling among the palm trees and luxury boutiques of Rodeo Drive. And long before the curated daily lives of average people became accessible through social media, we knew that what happened under the blinking lights of Las Vegas stayed in Las Vegas. Beyond residences with characteristic features like recessed casement windows and traditional courtyards, we may also be familiar with modern buildings that house exceptional healthcare facilities in the Southwest.

Despite the hybridity and complexity of its origin, Southwestern architecture is monotonous in one respect. Building design in the Southwestern states has long produced a sea of stucco, with nearly every structure plastered with stucco siding. Churches and missions built in California during the 1600s and 1700s are notable for their ornate parapets, smooth walls, arches, canopies — and white stucco cladding. Stucco continues to dominate into the present day. In fact, the material was applied to approximately 30 percent of Southwestern buildings erected in 2016.

02 The Threat of Fire

Familiarity and tradition alone do not explain stucco's continued dominance in the Southwest. Southwestern environments are highly susceptible to fire. In 2017, 43 people died, and 9,470 structures were destroyed in a wildfire season that consisted of 9,133 fires. Some 1.38 million acres burned resulting in a record cost of over $13 billion per the California Department of Forestry and Fire Protection (CAL Fire). As noted in "Climate Change and Fire in the Southwest," a working paper published by the Ecological Restoration Institute and Southwest Fire Consortium, the risk of fire is not expected to improve.

> *Decreases in relative humidity through the year 2089 are forecasted to increase days of higher danger in the Southwest and other parts of the American West, as measured by the energy release component (Brown et al. 2004). Temperature will also play a role; Spracklen et al. (2009) found that increasing temperature will lead to 54% more area burned across the American West in the period 2046–2055, compared to the period 1996–2005 (Kent, 2)*[1]

WILDFIRE FACTS | **2017**

1.38M
ACRES DESTROYED

$13B
COSTS ACCRUED

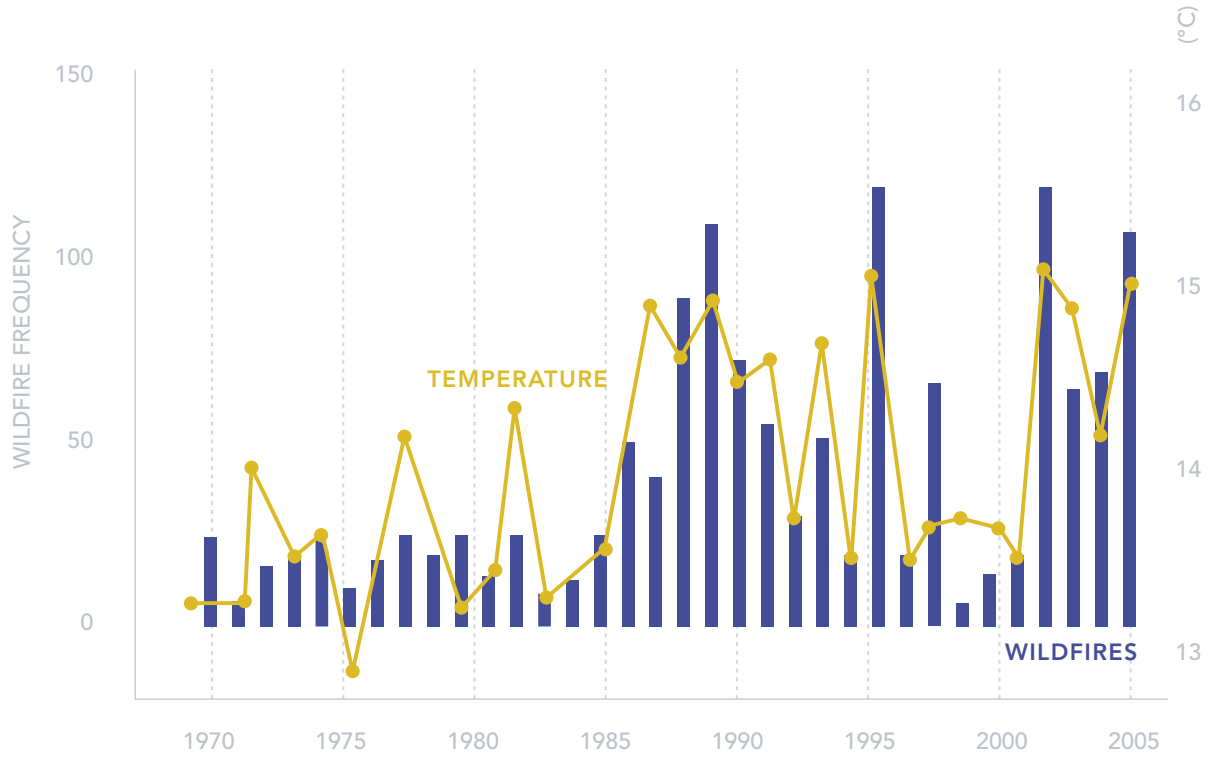
9,133
FIRES BURNED

9,470
STRUCTURES DESTROYED

43
LIVES LOST

1 Kent, L.Y. 2015. Climate Change and Fire in the Southwest. ERI Working Paper No. 34. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University: Flagstaff, AZ. 6 p.

Western US Forest Wildfires and Spring-Summer Temperatures



Source: Climate Change and Fire in the Southwest, Kent 3

With the ongoing risk of fire, it is no wonder that stucco continues to be dominant in the Southwest due to its wide recognition as a non-combustible cladding option.[1]

1 Kent, L.Y. 2015. Climate Change and Fire in the Southwest. ERI Working Paper No. 34. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University: Flagstaff, AZ. 6 p.

03 Fire-Resilient Alternatives?

Despite the monotony of the stucco-heavy built environment, architects are understandably wary of specifying alternative cladding options that compromise the fire-resiliency associated with stucco or are an aesthetic mismatch for the Southwest. Traditional wood siding, for example, offers warm, rich textures, but will not satisfy rigorous fire codes. Alternatives such as traditional brick compromise the Southwestern aesthetic, and the color palette of stacked stone can easily clash with the iconic rust red of the region. This status quo leaves designers feeling constrained, and at times, uninspired.

The simple answer to this design riddle is to add a fire-resilient complement to historic stucco styles rather than replacing stucco. As we will detail later in this book, extensive testing has proven that fiber cement — with its attractive range of hues and textures — is a fire-resilient option deserving of attention. Fresh, modern fiber cement accents can elevate and reinvigorate stucco-based designs while remaining appropriate for the historic aesthetic of the Southwest.

WOOD

BRICK

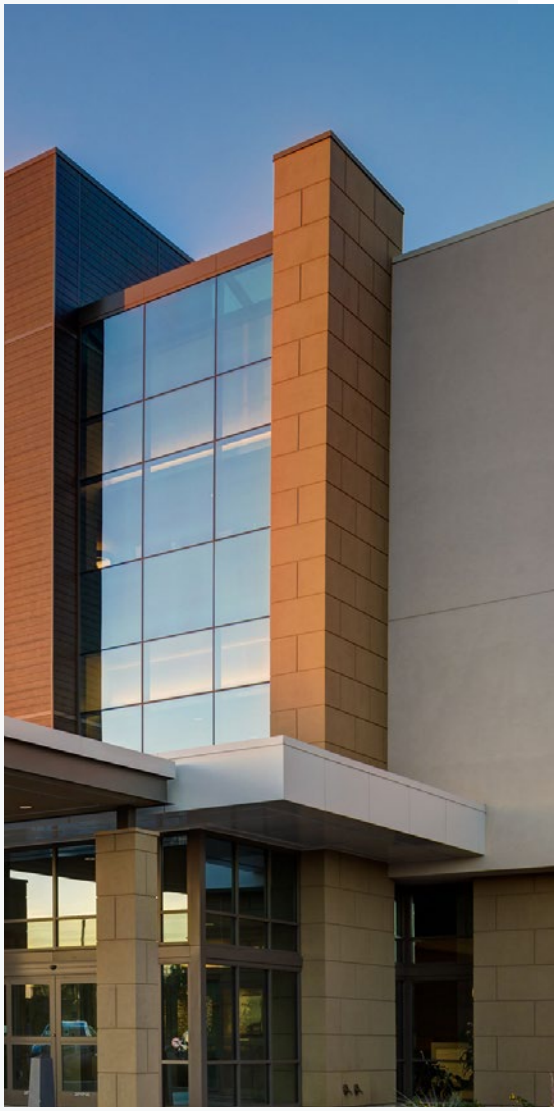
FIBER CEMENT

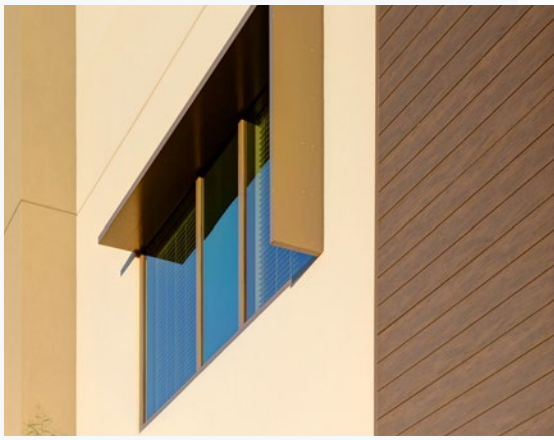
04 Complementary Physical Qualities

Fiber cement consists of fibrous materials such as wood pulp mixed with Portland cement, water and silica or fly ash. By virtue of its physical properties, fiber cement siding will experience only minimal damage from natural wear and tear. For example, unlike wood, fiber cement will rarely become bleached due to the region's many sunny days or be torn from a structure due to the harsh winds that periodically rip through the Southwestern states.

Like fiber cement, stucco also consists of Portland cement mixed with other elements: water, sand and lime. While fiber cement is delivered professionally mixed and pre-painted, stucco is mixed and installed by specialized contractors at the project site. Stucco often has a low upfront cost compared to other cladding options, but maintenance fees can inflate the total cost of stucco in the long term. Since stucco typically needs regular repainting and repair, fiber cement is an ideal low-maintenance complement given that it will not require such touch-ups.

In the following chart, we can see the complementary strengths of fiber cement relative to stucco. For this comparison, we used Nichiha's Fiber Cement Architectural Wall Panels.





	STUCCO	NICHIHA FIBER CEMENT
TEXTURES	• Varies on texture • Never has a completely smooth finish	• Offers an assortment of texture that stucco can't
COLOR	• Can be painted • Certain finishes minimize vibrant tones	• Widest variety of colors on the market • Illumination panels can be color-matched to any hue
MAINTENANCE	• Needs repair frequently • Impacts every decision for building updates • Very susceptible to weather damage	• Covered in a three-layer protective coat • Won't rot, warp, delaminate or fall victim to pests • Offer a stellar warranty on both the panels and the finish
FIRE RATING	• Has the "golden rating" for cladding	• Does not support combustion • Has a one-hour fire rating to an exterior wall • Has a Flame Spread Index rating of 0 • Has a Smoke Developed Index of 0
COST	• Cheapest siding on the market upfront • Long-term maintenance fees inflate cost	• More expensive than stucco, but still affordable • No long-term maintenance fees

Among the strengths of stucco is that it is noncombustible and has attained the "golden rating" for fire resilience. The next section will examine what it means for stucco to have the golden rating and discuss how applying fiber cement, as stucco's versatile complement, does not compromise fire resiliency.

05 Fire Ratings

What does it mean to say that stucco has the **"golden rating?"** Fire ratings are typically expressed in hours. The ratings indicate how long a building material or assembly can maintain its structural function or confine heat and flames so that occupants can escape.

Stucco has a fire rating of one hour according to tests such as ASTM E-119, a method for fire testing building construction materials published by the American Society for Testing and Materials (ASTM). This rating is "golden" and attractive in the Southwest and regions susceptible to fire.

Stucco is also appealing in fire-prone regions due to its non-combustibility. Combustibility is assessed using the method described in ASTM E-136, a testing standard that quantifies how building materials perform when heated in a vertical tube furnace at 1,382 degrees Fahrenheit.

STUCCO TEST RESULTS

"GOLDEN"
TOP INDUSTRY RATING

1 HR RATING
ASTM E-119

NO VISIBLE COMBUSTION
ASTM E-136

While fiber cement may not have a one-hour fire rating in standalone laboratory tests, testing shows that fiber cement can be safely applied as part of wall assemblies with a one-hour fire rating and wall assemblies that organizations such as the National Fire Prevention Association (NFPA) have designated as fire resistant. Fiber cement does not add or subtract from the hourly rating and does not support combustion. When exposed directly to flames, fiber cement will not add fuel to the fire but may exhibit undramatic smoldering. Additionally, ASTM E-84 tests of surface burning characteristics have shown fiber cement materials to qualify as Class A building materials due to a Flame Spread Index of zero. This means fiber cement does not easily ignite or spread flames.

Given how extensive testing has proven that fiber cement may be applied with wall assemblies with one-hour fire ratings without compromising occupant safety or reducing the fire rating, it should be clear how fiber cement and stucco can be safely applied together for vibrant Southwestern designs that do not compromise fire resiliency.

Further confirmation of fiber cement's suitability for Southwestern and fire-prone environments may be found in how fiber cement products have been tested and approved for use in areas designated by California's Office of the State Fire Marshal (SFM) as Wildland-Urban Interface Fire Areas (WUI) or Fire Hazard Severity Zones. WUI was established under Chapter 7A of the California building code and set standards and guidelines for materials and methods that increase the survivability of people and property through greater fire resilience. Assessment under Testing Standard CA SFM 12.7A-1, Exterior Wall Siding and Sheathing, proved that fiber cement products can help buildings resist ignition and protect their occupants. The next section provides an authentic example of how fiber cement can serve as an additional layer of protection outside of a testing environment.

FIBER CEMENT FIRE RESULTS

1 HR RATING COMPATIBLE

ON FIRE-RATED WALL ASSEMBLIES

RESISTS IGNITION

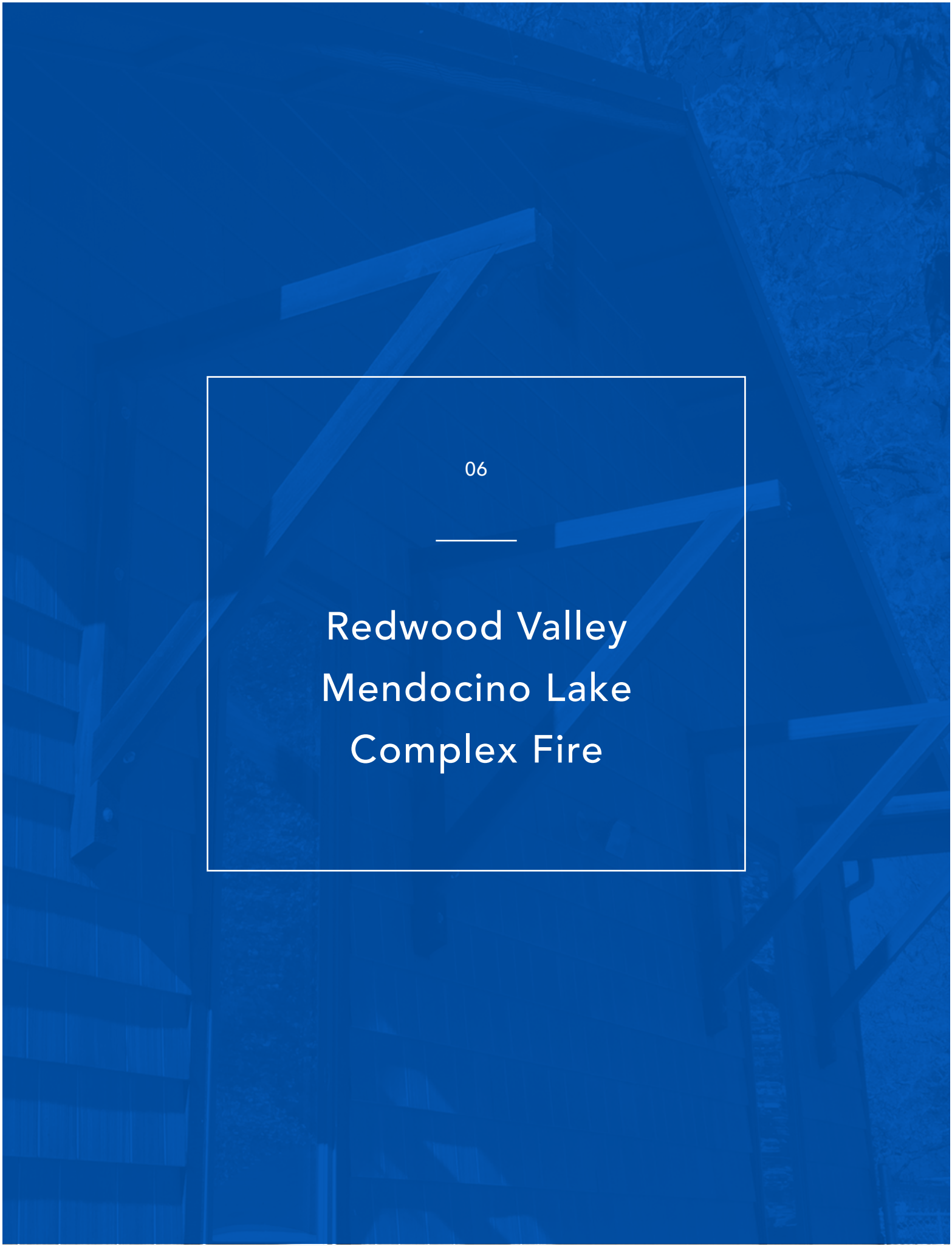
SMOLDERS, NOT BURNS

FLAME SPREAD INDEX: 0

ASTM E-84

PROTECTS BUILDING OCCUPANTS

CA SFM 12.7A-1



06

Redwood Valley Mendocino Lake Complex Fire

Consider the performance of fiber cement during the series of 250 wildfires that came to be known as the Northern California Firestorm. In October 2017, Bob Gates watched as the Mendocino Lake Complex Wildfire in Redwood Valley, California, incinerated every house in his neighborhood including his own home. No structure was left standing — except for a standalone home office on Gates's property which endured in part due to the resilience enabled by its fiber cement cladding from Nichiha.

The Gates home and office were located within Mendocino County in Redwood Valley, a small community of 2,300 residents. In the early hours of the morning, Bob awakened to the sight of the Redwood Valley Mendocino Lake Complex Fire, which ultimately killed eight people, burned 36,523 acres and destroyed 546 structures before it was contained.

"I woke up and looked out of our windows — which faced to the north and the south — and through the ones to the north, I could see that all of the ridges were on fire. It had to be a three- to-four-mile fire from ridge to ridge."

Flanked by vineyards to the west and north, their primary home was custom-built with a marble entryway, solid fir doors, hardwood floors, tropical hardwood in their bedrooms and redwood siding. Their property also included a 3,000-square-foot deck made of redwood and a home office. Linda and Bob Gates built the standalone home office on their five-acre property for Linda's successful art therapy practice. The 1,400-square-foot office was a second house that stood 175 feet away from the 2,000-square-foot house they built in 1992.

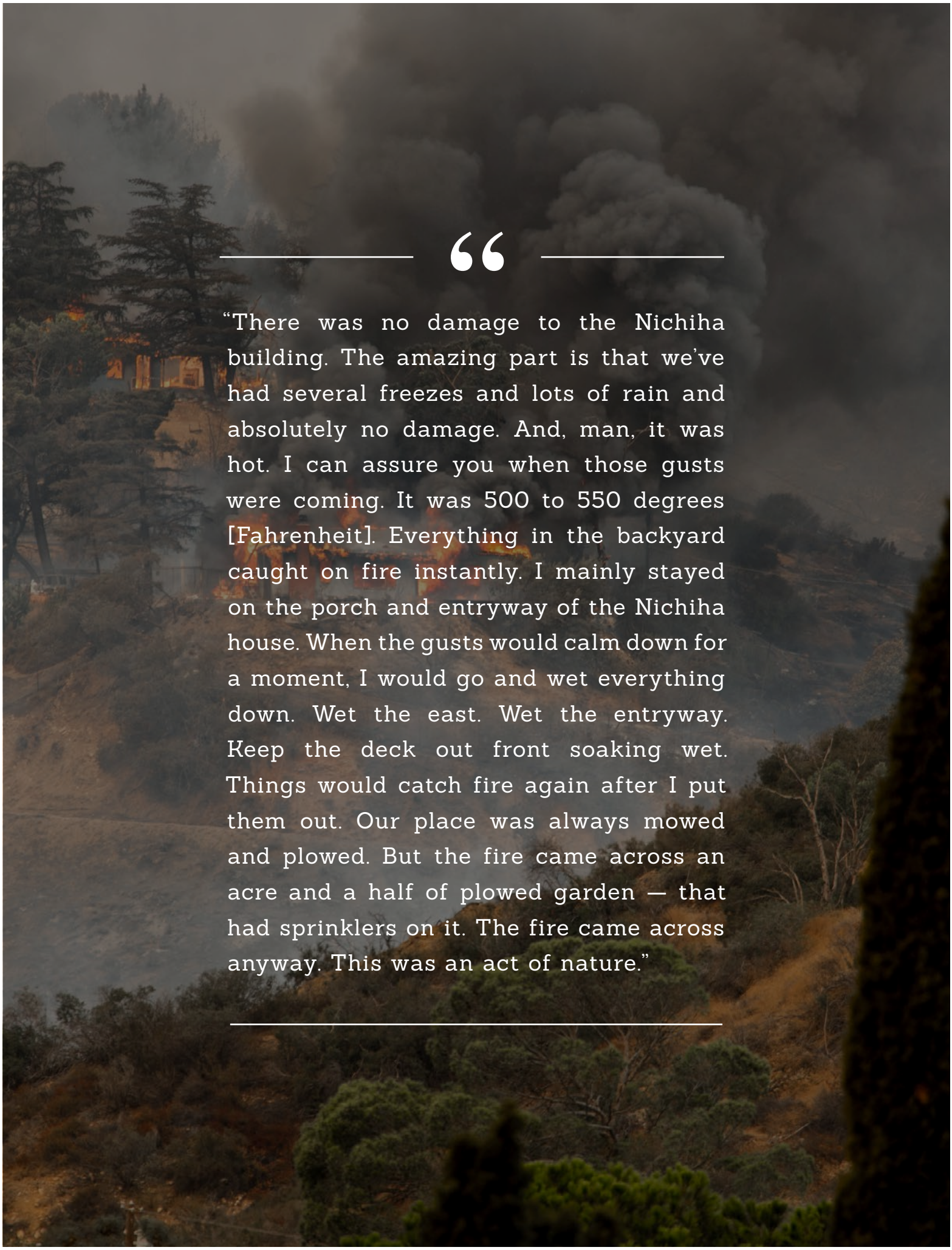
Unaware of the scale of the fire, Bob walked outside around 3:00 a.m. with the intention of fortifying the property against the incoming flames. With over twenty years of experience as a volunteer firefighter, Bob initially believed he could save their home. "I had originally thought we could fight it, but there is no way to really fight this. You can't expose yourself to this kind of fire. It will just kill you. It will burn all the hair off your arms, even if it doesn't feel that hot when it's blowing. I was lucky. We lost plenty of people. The children who were lost here, we knew. The older people who were lost here, I knew, personally."

Linda loaded up the family pets as she prepared to evacuate with her mother, who also lived at the home. After getting everyone in the car, Linda returned to the house for a laptop. Back in the car, she considered going back into the house a second time to retrieve her mother's wedding ring, but before she could do so, a nearby redwood tree caught fire and fell through the back of the house. It was a nightmare scenario. To escape, Linda had to drive a quarter of a mile through the fire with flames on both sides of the car as well as underneath and going over the top.

On the other side of the house, Bob retreated to the home office. "I was going to start putting some sprinklers on before the fire came. I got the hoses on the east, and the north, and the south side and I started wetting down the deck. The front was a redwood deck, which was 10 feet by 6 or 7 feet. If the deck caught on fire, it would burn the building down from the other side."

Although Bob would continue working to preserve the rest of his property, his custom-built house did not survive. "There was no time to be terrified. Our house burned down in 15 minutes.

> "There was no time to be terrified. Our house burned down in 15 minutes. The winds were blowing hard. All of the aluminum in the house was blown into a big pool where the living room used to be."



“There was no damage to the Nichiha building. The amazing part is that we’ve had several freezes and lots of rain and absolutely no damage. And, man, it was hot. I can assure you when those gusts were coming. It was 500 to 550 degrees [Fahrenheit]. Everything in the backyard caught on fire instantly. I mainly stayed on the porch and entryway of the Nichiha house. When the gusts would calm down for a moment, I would go and wet everything down. Wet the east. Wet the entryway. Keep the deck out front soaking wet. Things would catch fire again after I put them out. Our place was always mowed and plowed. But the fire came across an acre and a half of plowed garden — that had sprinklers on it. The fire came across anyway. This was an act of nature.”

The winds were blowing hard. All of the aluminum in the house was blown into a big pool where the living room used to be."

The wind gusts converted every bit of matter it could capture into flaming projectiles. Leaves from a nearby cemetery and debris from local vineyards and trees were hurled in every direction as baseball-sized clumps. For at least three hours, with winds ranging from 40 to 60 miles per hour, the home office was battered with embers.

All of the bushes on the property caught fire. The flames incinerated 120-foot trees that Bob had planted himself in 1985 when he first moved to the area.

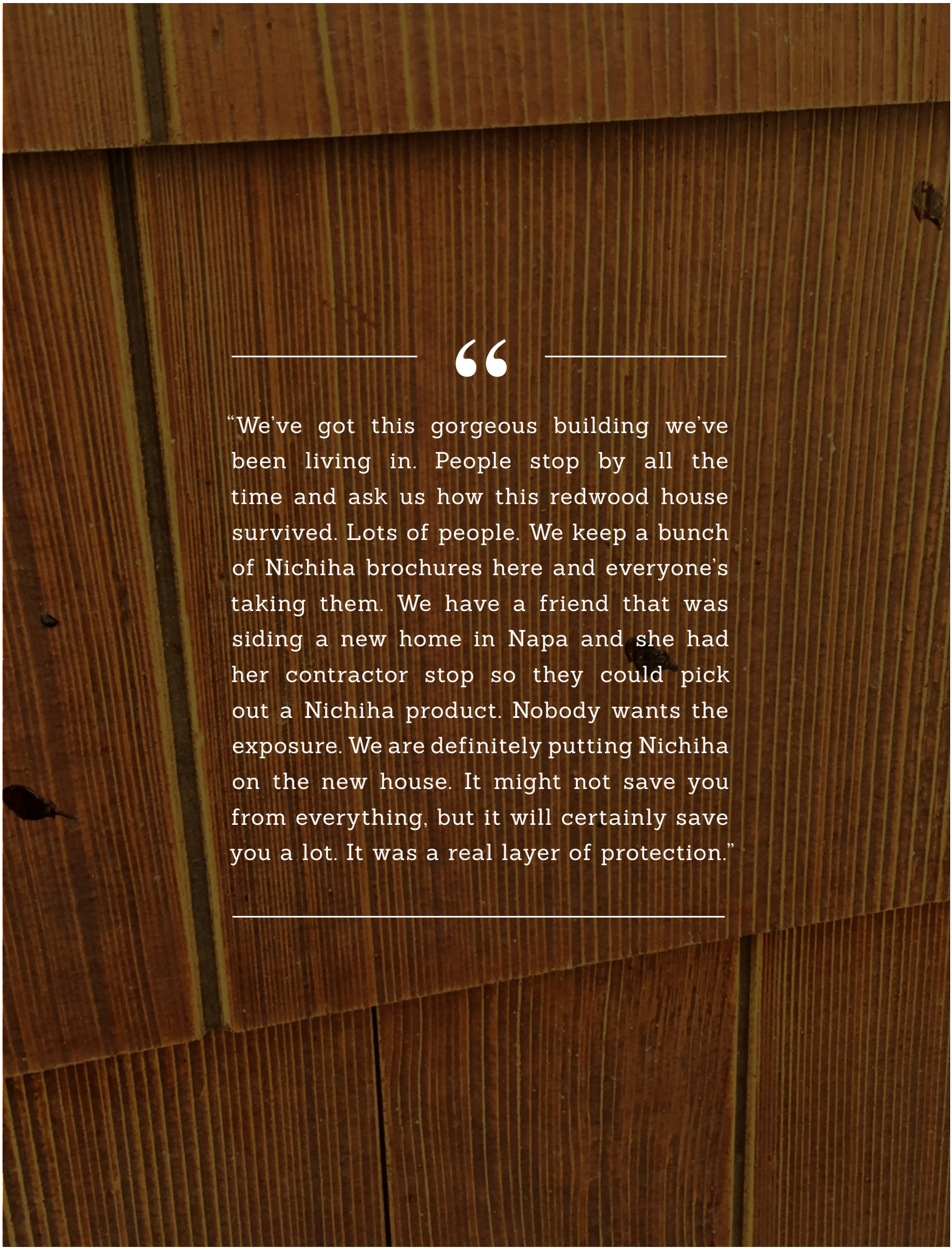
Still, the Nichiha siding, and the structure it protected, endured.

"This stuff is amazing. It was battered all night long, with embers like ping-pong balls hitting the siding. For about three hours."

Ultimately, Bob made it through the event without injury. Sadly, none of the homes in Bob's neighborhood survived, including the custom-built Gates home. With over 200 houses incinerated, the community lost about a quarter of its homes in just a few hours.

Although the Gates family lost their primary home, they have continued to live on their property by moving into the home office.

"This stuff is amazing. It was battered all night long, with embers like ping-pong balls hitting the siding. For about three hours."



“We’ve got this gorgeous building we’ve been living in. People stop by all the time and ask us how this redwood house survived. Lots of people. We keep a bunch of Nichiha brochures here and everyone’s taking them. We have a friend that was siding a new home in Napa and she had her contractor stop so they could pick out a Nichiha product. Nobody wants the exposure. We are definitely putting Nichiha on the new house. It might not save you from everything, but it will certainly save you a lot. It was a real layer of protection.”

07 Elevate Designs, Escape Monotony

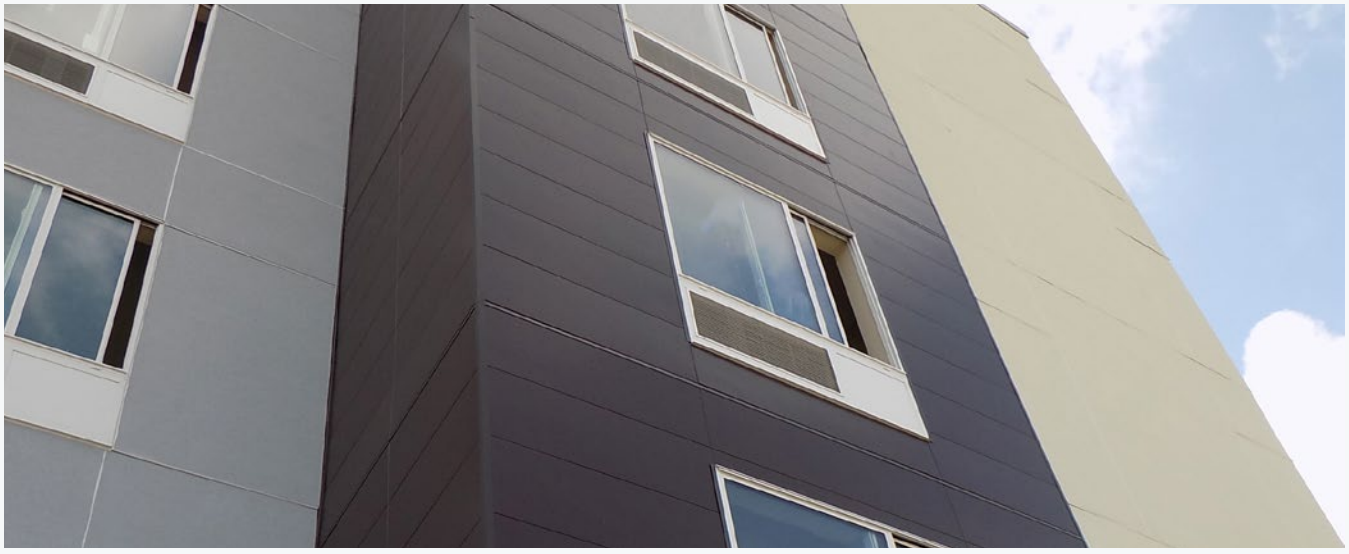
As we've discussed, stucco is part of the Southwest's historic identity. An architect who designs another stucco-clad building ensures that the structure meshes with the current landscape, but without differentiation, the project becomes lost in the sea of stucco. Navigating too far from the familiar legacy siding may turn the project to an aberration, a jarring interruption of norms rather than evidence of forward thinking or signature style.

Architects understand the value of creating spaces that inspire and engage their clients and all people who encounter their work. Beyond the design aesthetic, this concern relates to how humanistic designers create with careful consideration for the overall well-being and experience of a structure's occupants. In Welcome to Your World: How the Built Environment Shapes Our Lives, architectural critic Sarah Williams Goldhagen draws from cognitive neuroscience to discuss how our emotions, well-being, and overall cognition are in many ways a function of the built environment.

Addressing the pitfalls of monotony, Goldhagen writes:

> *Patterns in the absence of complexity repel us. A look at typical developer-built tracts of residences is enough to know that sameness and repetition dull the senses…the repetition of simple patterns repeated seemingly ad infinitum, at a very large scale, becomes boring or even downright enervating. This is owing to our human craving for cognitive stimulation, as important to us practically as oxygen is to us physically. (232-233)*[1]

With fiber cement, architects can finally break the monotony of the stucco-heavy environment without compromising fire resiliency or the Southwestern aesthetic. Let's explore simple design tips and photos that illustrate how fiber cement can complement rather than clash with the unique tones, textures and makeup of stucco.



1 Goldhagen, Sarah Williams. Welcome to Your World: How the Built Environment Shapes Our Lives. Harper, an Imprint of Harper Collins Publishers, 2017.

08 Fiber Cement and Creative Freedom

The creative freedom fiber cement offers architects seeking to elevate common stucco designs starts with how it can be processed and pressed to create boards and architectural wall panels of varying sizes, lengths, thicknesses and textures. These fiber cement products can closely emulate the appearance and textures of a wide range of materials including stone, metal, concrete and wood. For example, Linda and Bob Gates selected Nichiha Sierra Shake siding for their home office because it would match the redwood siding of their house without requiring significant maintenance.

Bob said, "The Nichiha product came painted, and it looked like redwood shingles. The depth and thickness allowed it to be grooved. It looks like we put it up there yesterday. And I come from a painter's family. That really cuts the cost, if you think about it. One step and done."

Further qualifying fiber cement as a protean complement in the Southwest, fiber cement offers the widest variety of colors on the market and can match almost any hue of stucco. Plus, fiber cement can retain its painted appearance for 12 years or more. Some fiber cement manufacturers — such as Nichiha — offer 15-year warranties on decorative factory finishes and colors.

> "The Nichiha product came painted and it looked like redwood shingles. The depth and thickness allowed it to be grooved. It looks like we put it up there yesterday. And I come from a painter's family. That really cuts the cost, if you think about it. One step and done."

DESIGN TIP 1

Choose textures that complement

While its range of finishes is somewhat limited compared to fiber cement, stucco communicates a level of depth that helps personalize a structure. Whether the finish is coarse or flat, it can be challenging to choose complementary cladding with the right texture to pair with stucco. But with the right fiber cement, this challenge is better understood as an opportunity.

First, decide whether the building would benefit from emphasizing the consistency of the stucco or blending with it. If harmonizing works best, a flat cladding would easily pair with a smooth or Santa Barbara finish, while a rougher siding might match with lace or float texture.

A bolder move is to highlight the natural feel of stucco, perhaps by putting a cat face or dash texture with a siding that speaks to the rustic approach. The feel of stucco is also beautiful when side-by-side with a wood panel, as the natural tones integrate flawlessly.

DESIGN TIP 2

Choose tones that balance

While traditionally kept in a neutral or earth tone, stucco can be painted any color. That's why it is essential to choose siding that meshes exactly with the color scheme. After all, a tonal imbalance on a building is often the first thing that people notice.

To ensure that this doesn't happen, try a fiber cement siding that can be matched precisely. Check with your supplier to ensure that they offer color matching, no matter if it is a classic neutral or a modern neon.

Contrasting tones are also a current trend. An easy way to honor the region with a modern twist is to use the natural desert coloring as inspiration. Pair these warm hues with cool wood touches to spark a color marriage that glows.

DESIGN TIP 3

Pair stucco with low-maintenance materials

Stucco requires significant maintenance. When adding supplemental cladding to enhance stucco-based designs, it is practical to pair stucco with a low-maintenance complement such as fiber cement. As discussed earlier in this book, fiber cement can retain its painted appearance for 12 years or more and will rarely become bleached due to solar exposure in Southwestern regions.

Nichiha Fiber Cement Architectural Wall Panels are great examples of durable, low-maintenance siding products. When balanced with stucco, these panels elevate the most common Southwest building material by adding color and texture, allowing the simple beauty of stucco to shine.

With a history in the region that stretches back centuries, stucco stands to remain a core component of commercial and residential designs in the Southwest. By applying versatile fiber cement as a complement to stucco-based designs, architects can innovate within the sea of stucco without disrupting the historic Southwestern aesthetic or, as extensive testing has proven, compromising a project's fire resilience. And even if a project design requires a mix of cladding styles, fiber cement boards and architectural wall panels are capable of becoming a single source for multiple looks and a vast pallet of vibrant colors.

09

Quick Reference Guide: Standards and Terminology

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM International is a not-for-profit organization that develops voluntary, consensus standards for material classification, specifications, terminology, guides, practices and test methods. ASTM provides widely-used fire and flammability testing methods for evaluating the characteristics of building materials related to ignition, burning and combustion. All around the world, building codes and fire-related regulations incorporate ASTM standards. ASTM Testing methods related to fiber cement, fire and flammability include:

- ASTM C-118/6: This standard is a method for assessing the flexural strength of fiber cement flat sheets and a sheet's suitability for its intended application. Type A sheets are for exterior applications and will be subject to direct sun, rain or snow. Type B sheets are also intended for exterior applications, but are not subject to direct sun, rain or snow. Each sheet is assigned a grade of one, two, three or four according to its flexural strength.

- ASTM C-518: This standard describes a test method for assessing the thermal transmission properties of a material. A material's resistance to the transfer of thermal energy is quantified in its R-value.

- ASTM E-84: This standard describes a test method for assessing the surface-burning characteristics of a building material by exposing the material to fire and measuring both flame spread and the density of any smoke produced.

- ASTM E-119: This standard describes a test method for establishing the fire-resistance rating of a building material. Fire-resistance is measured in the amount of time a building material or assembly can maintain its structural function or confine a fire so that occupants can escape. The ratings are expressed as hours.

- ASTM E-136: This standard describes a test method for assessing the combustibility of building materials by quantifying how the materials perform when heated in a vertical tube furnace at 1,382 degrees Fahrenheit.

- ASTM E-228: This standard describes a test method for determining the thermal expansion of a building material when it is subject to temperature changes and thermal stresses.

- **Combustible and Non-combustible:** Combustible building materials easily ignite and burn. When evaluating building materials for combustibility relative to other materials, the flame spread index and heat release rate are key metrics. An example of a combustible building material is wood siding that has not been treated with a fire retardant. Materials that resist ignition and do not burn when tested under conditions defined by ASTM E-136 are designated as non-combustible.

- **Fire-resistant:** Fire-resistance is measured in the amount of time a building material or assembly can maintain its structural— function or confine a fire so that occupants can escape. With the method described in ASTM E-119, the ratings are expressed as hours.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA): The NFPA is a nonprofit codes and standards organization dedicated to reducing harm caused by fire by establishing criteria for design, building, installation and service. With approximately 9,000 volunteers organized into more than 250 technical committees, the NFPA has developed more than 300 consensus codes and standards concerning fire and fire-related risks. These standards include:

- NFPA 268: This standard describes a test method for measuring and describing the ignitability of exterior wall assemblies and how the assemblies might contribute to the growth of a fire.

- NFPA 285: This standard describes a fire test procedure for evaluating vertical and lateral fire propagation characteristics of wall assemblies and panels when applied with combustible components such as foam plastic insulation. The specific combination of components that make up the tested assembly is evaluated for how they impact the non-combustibility of exterior walls.

STANDARDS COUNCIL OF CANADA (SCC): Established as a Crown corporation, or a Canadian state-owned enterprise, the SCC accredits standards-developing organizations, coordinates Canada's input into international standards, develops roadmaps for subject areas requiring standardization, and reviews standards for approval as National Standards of Canada. Approved standards include:

- CAN/ULC S102: This standard was developed by the Underwriters Laboratory of Canada (ULC) and recognized by the SCC. It describes a method for testing the surface burning characteristics of a building material.

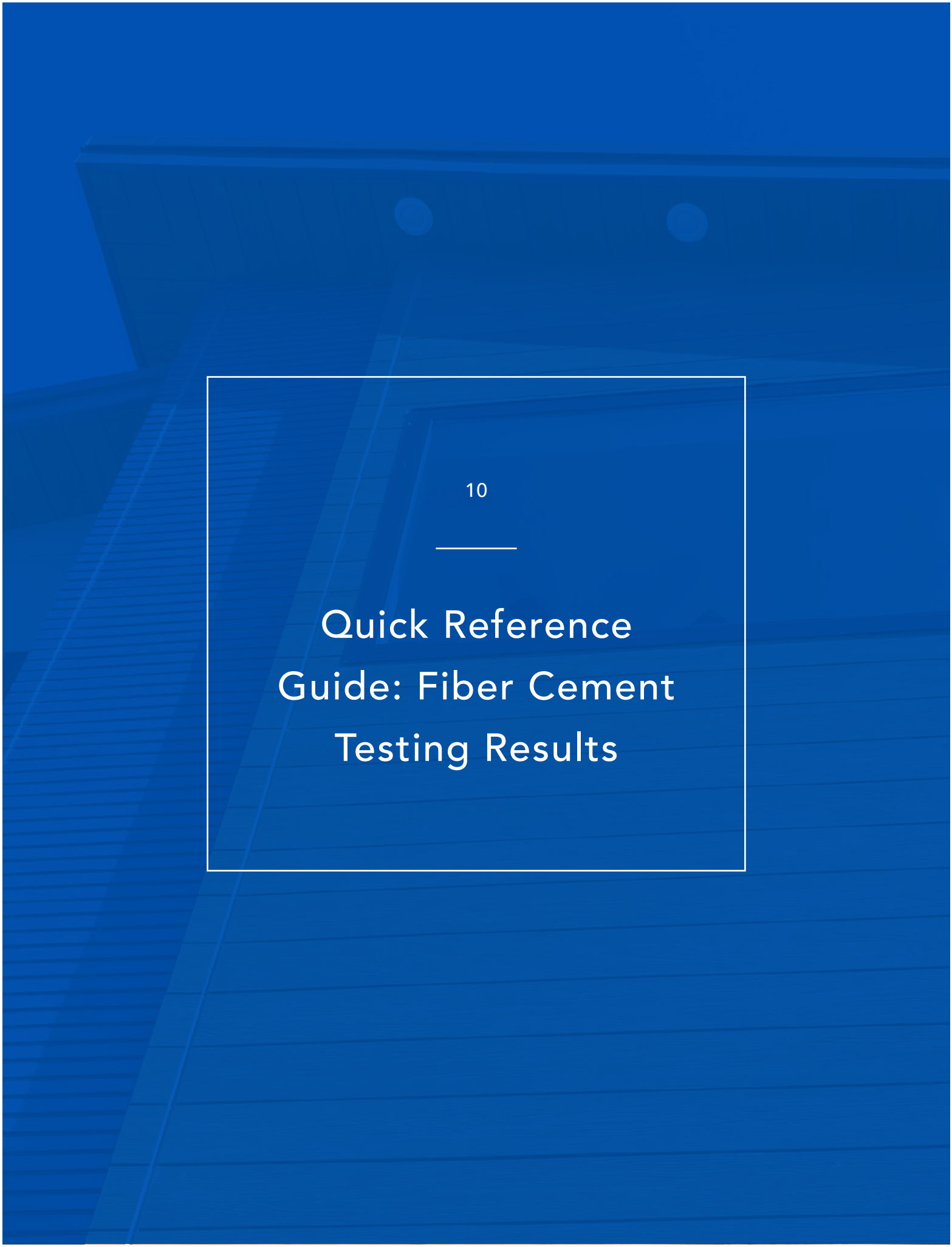
- CAN/ULC-S134-13: Also developed by ULC and recognized by the SCC, this standard describes a fire test method for the evaluation of exterior wall assemblies.

UNDERWRITERS LABORATORY, INC.® (UL®): UL is an independent company that specializes in safety science. UL develops standards used to test product components, materials, and systems. Underwriters Laboratory of Canada (ULC), a member of the UL family of companies, is accredited by the SCC. UL standards concerning fire and fire-related risks include:

- UL 723: This standard describes a method for evaluating the spread of flame over the surface of a material exposed to fire and measuring the density of the smoke developed. This information helps to determine the comparative surface-burning characteristics of the material.

WILDLAND-URBAN INTERFACE (WUI) FIRE AREAS: California's Office of the State Fire Marshal (SFM) has designated certain areas as Wildland-Urban Interface Fire Areas (WUI) or Fire Hazard Severity Zones. WUI was established under Chapter 7A of the California building code and set standards and guidelines for materials and methods that increase the survivability of people and property through greater fire resilience. Standards specific to application in WUI include:

- CA SFM 12.7A-1: This standard describes a test used to determine the performance of exterior walls — including siding and sheathing — when exposed to direct flames. California requires that this test be performed by an SFM-accredited laboratory



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Quick Reference Guide: Fiber Cement Testing Results

As an example of fiber cement performance, here are a series of test results earned by fiber cement products manufactured by Nichiha. The products discussed below meet the requirements of ASTM C-118/6 to be classified as a Type A, Grade II fiber cement sheet.

The ASTM C-518 test results show the Nichiha Brick, Stone & Block Fiber Cement Panels to have a thermal resistance or R-value of 1.23. The hot plate temperature recorded was 99.88˚F and the cold plate temperature recorded was 51.18˚F. The mean temperature recorded during the test was 75.53˚F.

On the ASTM E-84 Surface Burning Characteristics Test:

- *Flame Spread Index:* The maximum distance the flame spreads along the length of the sample from the end of the igniting flame is determined by observation. The Flame Spread Index (FSI) of the material is determined by rounding by Calculated Flame Spread (CFS) as described in UL 723.

Test Sample	Maximum Flame Spread (ft.)	Time of Maximum Flame Spread (min.)	CFS	FSI
Nichiha AWP (EX-Series)	0.0	-	0.0	0

- *Smoke Developed Index:* The Smoke Developed Index is determined by rounding the Calculated Smoke Developed (CSD) as described in UL 723. The CSD is determined by the output of a photoelectric circuit operating across the furnace flue pipe. A curve is developed by plotting values of light absorption (decreased in cell output) against time. The CSD is derived by expressing the net area under the curve for this material as a percentage of the net area under the curve for untreated red oak.

Test Sample	CSD
Nichiha AWP (EX-Series)	0.9

On the CAN/ULC S102 Surface Burning Characteristics Test shows a Flame Spread Rating of 0 and a Smoke Developed Characterization of 5.

On the ASTM E-119/CAN/ULC S101-07 Fire Resistance of Wall Assembly Test, the wall was evaluated with the exterior (Nichiha face) exposure. The walls successfully endured a 60-minute fire exposure without developing excessive unexposed surface temperatures or allowing flaming on the unexposed side of the assembly. At the conclusion of the 60-minute fire exposure, the maximum unexposed surface temperature was 163 F, and the maximum average surface temperature was 156 F. The wall met the requirements for a 1-hour fire resistance rating under load-bearing conditions of 300 pounds per foot.

On the ASTM E 228 Physical Properties Test, the Nichiha Brick, Stone and Block Fiber Cement Panels successfully comply with the requirements specified in ICC-ES.

On the National Fire Protection Association (NFPA) 268 – 2012 Edition – Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source Test, the wall assembly met the acceptance criteria given in the NFPA 268 standard. No sustained flaming exhibited.

On the National Fire Protection Association (NFPA) 285 – 2012 Edition – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies containing Combustible Components, the wall assembly met the acceptance criteria given in the NFPA 285 standard.

- No vertical flame propagation to 10 feet above the top of the window.
- No lateral flame propagation to 5 feet from the centerline of the window.
- Surface temperature readings did not exceed 1000˚ F at any time.
- Temperatures in the air cavity did not exceed 1000˚ F at any time.
- Flame propagation did not occur in the second-floor test room at any time, nor did temperatures exceed 500˚ F at any time.

On the CAN/ULC S134-13 – Standard Method of Fire Test for Evaluation of Exterior Wall Assemblies, the wall assembly met the acceptance criteria given in the CAN/ULC S134 standard.

- No vertical flame propagation to 5 meters above the top of the window.
- Highest flames measured at 2.5 m
- The maximum one-minute averaged value of the total heat flux density at 3.5 m above the top of the window did not exceed 35 kW/m2.
- Max one-minute averaged value was 25.4 kW/m2

Nichiha AWP successfully met the requirements of NFPA 285 as tested by Hughs Associates, Inc.

Nichiha AWP also met International Building Code compliance as determined by Priest & Associates Consulting.

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