Building to Survive Wildfires

WiReS Conference

February 2023

Architect Drew Hubbell

Surprise! Buildings Made of Straw Bale are Wildfire-Resilient

Construction Technologies for Sustainable Wildfire-Resilient Buildings

Drew Hubbell
Hubbell & Hubbell Architects

Smoketree Ranch
H&H, 2006

Hubbell & Hubbell History with Straw Bale

1995: Founded with father James Hubbell

1997: H&H designed the first straw bale building permitted in San Diego County after helping to educate building officials

2003: H&H designed the First Straw Bale Commercial Building that was permitted in City of San Diego (The Friends Center) after creating a special inspection program for City Inspectors to use when reviewing straw bale construction

Since then, we have designed over 45 straw bale structures throughout Southern California

Kubicek Home

Photo by Pavlina Kubicek

The Friends Center

California Straw Building Association (CASBA) History

- Works to express the fire-resistant nature of straw building so that these types of structures can be accepted into WUI regulations

- Rigorous building codes that govern it

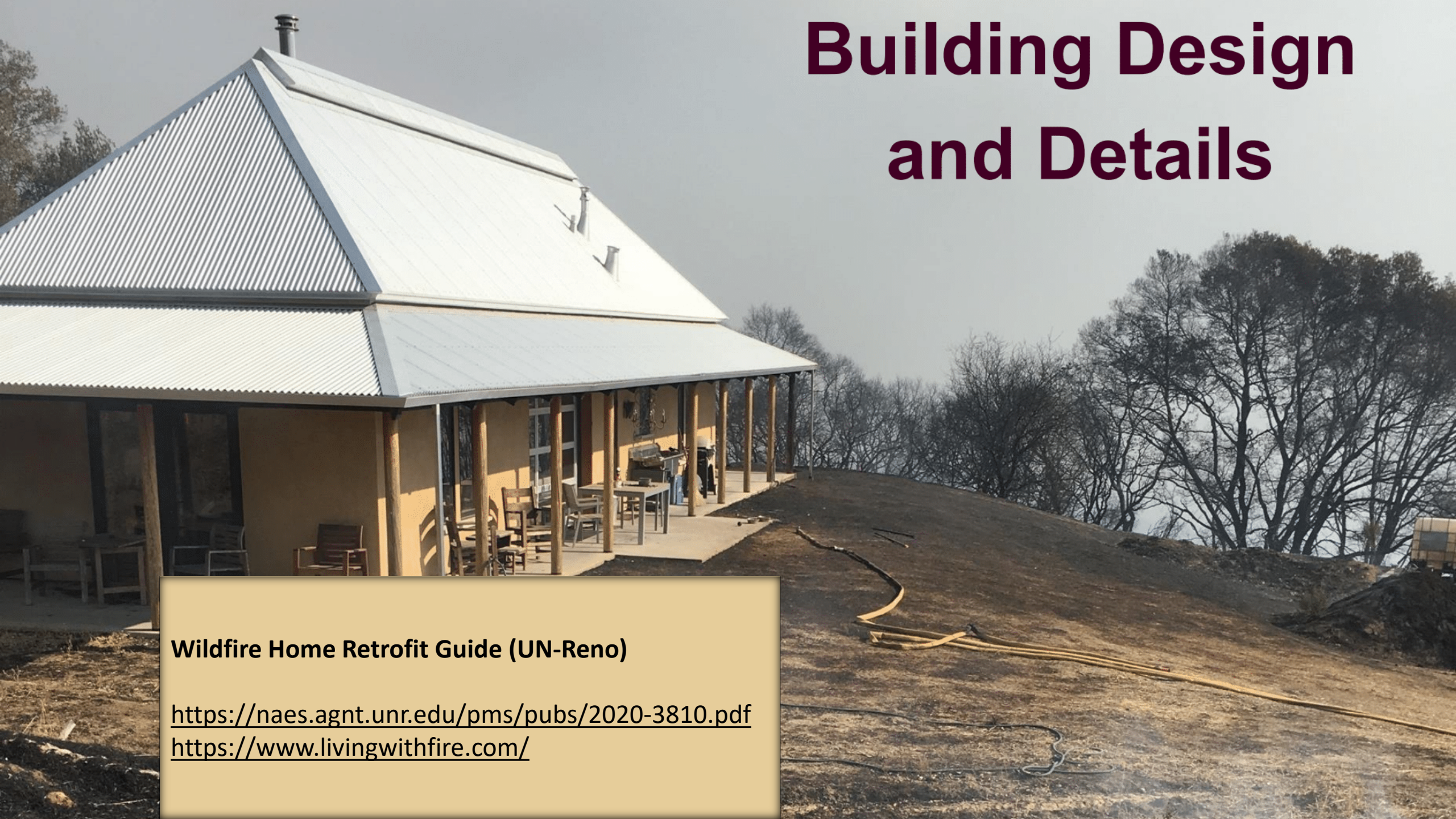
- Strawbale buildings built to code (i.e., Appendix AS in the International Residential Code) have better fire resistance (up to two hours) than ordinary wood-frame structures (typically less than one hour)

- Wind and seismic resistance
- Embodied carbon
- Superior Insulating Qualities
- Insuring strawbale buildings = enhances insurer's underwriting appetite and market penetration with a class of business that is extremely environmentally friendly and resilient without jeopardizing loss ratios

Kubicek Home

Photo by Pavlina Kubicek

Building Design and Details



Wildfire Home Retrofit Guide (UN-Reno)

https://naes.agnt.unr.edu/pms/pubs/2020-3810.pdf
https://www.livingwithfire.com/

CHAPTER 7A [SFM]

MATERIALS AND CONSTRUCTION METHODS FOR EXTERIOR WILDFIRE EXPOSURE

SECTION 701A
SCOPE, PURPOSE AND APPLICATION

701A.1 Scope. *This chapter applies to building materials, systems and/or assemblies used in the exterior design and construction of new buildings located within a Wildland-Urban Interface Fire Area as defined in Section 702A.*

701A.2 Purpose. *The purpose of this chapter is to establish minimum standards for the protection of life and property by increasing the ability of a building located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland-Urban Interface Fire Area to resist the intrusion of flames or burning embers projected by a vegetation fire and contributes to a systematic reduction in conflagration losses.*

701A.3 Application. *New buildings located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland-Urban Interface Fire Area designated by the enforcing agency for which an application for a building permit is submitted on or after December 1, 2005, shall comply with the following sections:*

1. ***704A.1—Roofing***
2. ***704A.2—Attic Ventilation***

701A.3.1 Alternates for materials, design, tests, and methods of construction. *The enforcing agency is permitted to modify the provisions of this chapter for site-specific conditions in accordance with Appendix Chapter 1, Section 104.10. When required by the enforcing agency for the purposes of granting modifications, a fire protection plan shall be submitted in accordance with the California Fire Code, Chapter 47.*

701A.3.2 New buildings located in any fire hazard severity zone. *New buildings located in any Fire Hazard Severity Zone shall comply with one of the following:*

1. ***State Responsibility Areas.*** *New building located in any Fire Hazard Severity Zone within State Responsibility Areas, for which an application for a building permit is submitted on or after January 1, 2008, shall comply with all sections of this chapter.*
2. ***Local Agency Very-High Fire Hazard Severity Zone.*** *New buildings located in any Local Agency Very-High Fire Hazard Severity Zone for which an application for a building permit is submitted on or after July 1, 2008, shall comply with all sections of this chapter.*
3. ***Wildland-Urban Interface Fire Area designated by the enforcing agency.*** *New buildings located in any Wildlan d-Urban Interface Fire Area designated by the enforcing agency for which an application for a building permit is submitted on or after January 1, 2008, shall comply with all sections of this chapter.*

701A.3.2.1 Inspection and certification. *Building permit applications and final completion approvals for buildings within the scope and application of this chapter shall comply with the following:*

701A.3.2.2 *The local building official shall, prior to construction, provide the owner or applicant a certification that the building as proposed to be built complies with all applicable state and local building standards, including those for materials and construction methods for wildfire exposure as described in this chapter.*

701A.3.2.3 *The local building official shall, upon completion of construction, provide the owner or applicant with a copy of the final inspection report that demonstrates the building was constructed in compliance with all applicable state and local building standards, including those for materials and construction methods for wildlife exposure as described in this chapter.*

701A.3.2.4 *Prior to building permit final approval the property shall be in compliance with the vegetation clearance requirements prescribed in California Public Resources Code 4291 California Government Code Section 51182.*

SECTION 702A
DEFINITIONS

For the purposes of this chapter, certain terms are defined below:

CDF DIRECTOR *means the Director of the California Department of Forestry and Fire Protection.*

FIRE PROTECTION PLAN *is a document prepared for a specific project or development proposed for a Wildland Urban Interface Fire Area. It describes ways to minimize and mitigate potential for loss from wildfire exposure.*

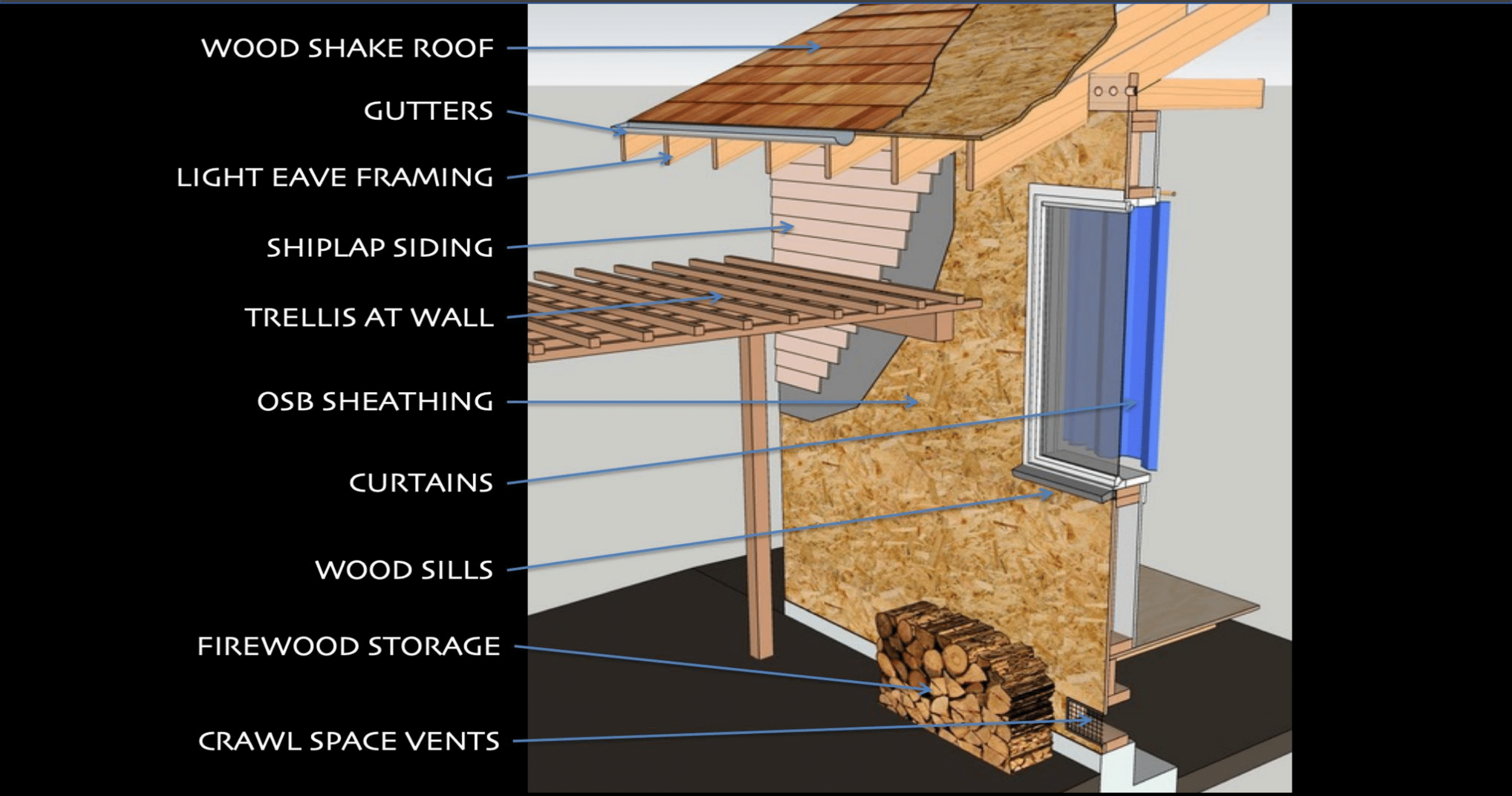
The Fire Protection Plan shall be in accordance with this chapter and the California Fire Code, Chapter 47. When required by the enforcing agency for the purposes of granting modifications, a fire protection plan shall be submitted. Only locally adopted ordinances that have been filed with the California Building Standards Commission or the Department of Housing and Community Development in accordance with Section 101.8 shall apply.

FIRE HAZARD SEVERITY ZONES *are geographical areas designated pursuant to California Public Resources Codes Sections 4201 through 4204 and classified as Very High, High, or Moderate in State Responsibility Areas or as Local Agency Very High Fire Hazard Severity Zones designated pursuant to California Government Code, Sections 51175 through 51189. See California Fire Code Article 86.*

Wildland Urban Interface (WUI)
California Code since 2007
Chapter 7A – CA SFM

https://osfm.fire.ca.gov/divisions/fire-engineering-and-investigations/building-materials-listing/

The Old Way


WOOD SHAKE ROOF
GUTTERS
LIGHT EAVE FRAMING
SHIPLAP SIDING
TRELLIS AT WALL
OSB SHEATHING
CURTAINS
WOOD SILLS
FIREWOOD STORAGE
CRAWL SPACE VENTS

The New Way

CLASS A ROOF W/ UNDERLAYMENT

GUTTERS W/ SCREENS

HEAVY TIMBER EAVE OR ENCLOSED

NO ROOF VENTS! OR EMBER-PROOF

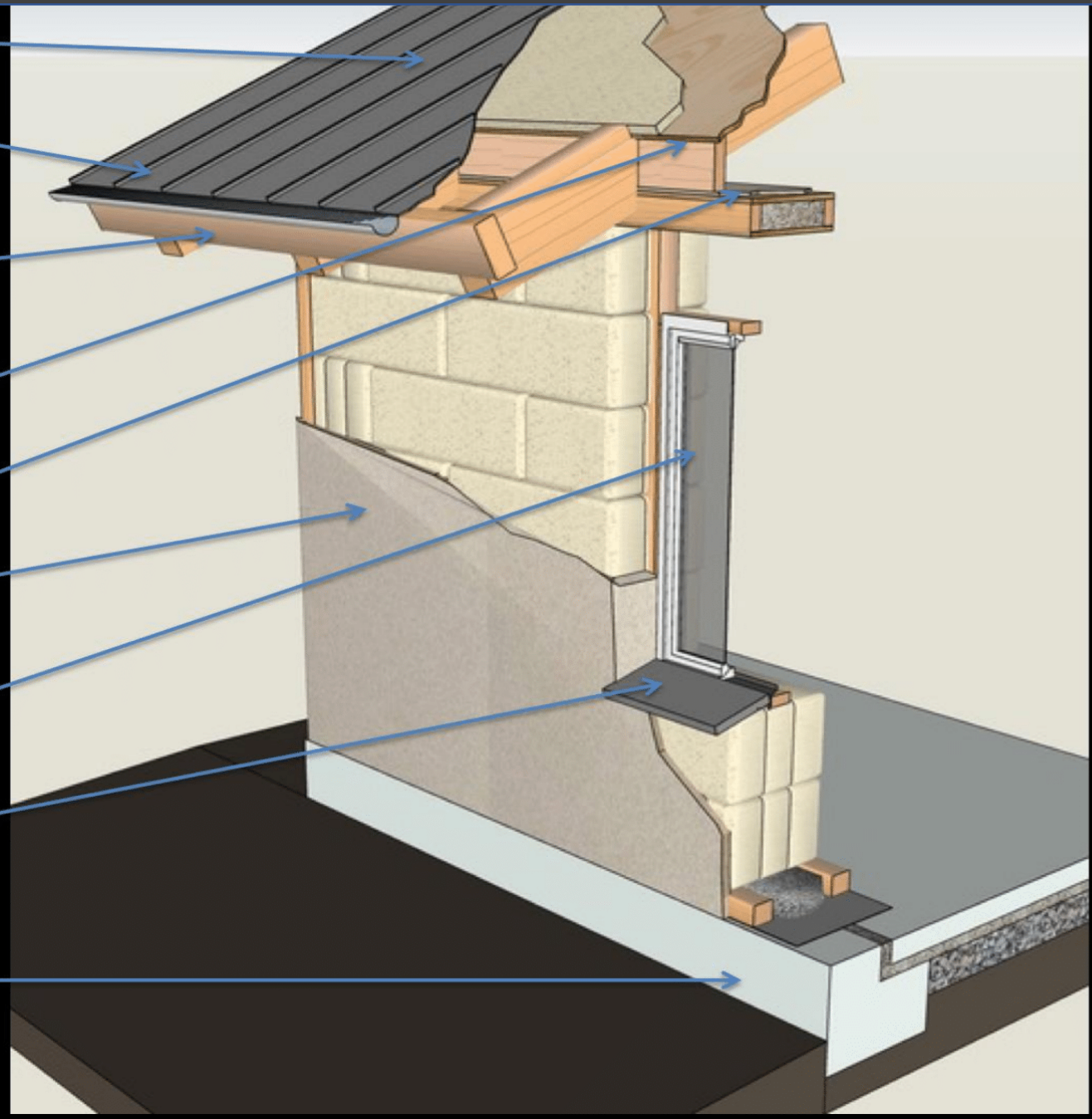
FP CAP ON BALES

FABULOUS PLASTER FINISH

NON-COMBUSTIBLE WINDOWS SET BACK

NON-COMBUSTIBLE SILLS & TRIM

NO CRAWLSPACE VENTS (OR EMBER-PROOF)



SPECIAL REPORT

A straw-bale survival story

Fire-resistant details like those in California's building codes can make conventional wood-framed houses safer in the event of a fire. But other types of construction may be inherently better. One of them, according to David Arkin, an architect in Berkeley, California, and director of the California Straw Building Association (CASBA), is straw-bale construction.

A few weeks after the Tubbs fire in Northern California last October, Arkin passed along a hair-raising email he'd received from a client whose straw-bale house successfully weathered the event.

Edward Doody woke up in his Mendocino County home at 2:30 in the morning as fire approached. He decided to make a run for it with his dog, but their escape path was blocked, so Doody and his neighbor retreated to the house and waited out the fire.

"Huge booms resonated through the night air as propane tanks exploded, igniting more houses throughout the night," Doody wrote. "The overused analogy to a war zone comes to mind."

Doody's house survived. His neighbors' did not.

"We've observed with our own straw-bale and earth homes, and have heard stories of other similar buildings, that plastered walls combined with a metal roof and other fire-resistant detailing, and with a defensible space around the buildings, offer a good chance of surviving a fire," Arkin says, "and we've seen these homes survive in situations where nearby homes were lost."

Arkin says an assembly consisting of rice straw bales stacked on edge and finished with lime-cement plaster achieved a two-hour fire rating in one ASTM test, at least double what might be expected from a standard stick-framed house. "That does not automatically mean that all other straw-bale wall assemblies meet a two-hour rating," he says. " But can we conclude that they are likely more fire resistant than most other typical residential wall assemblies? Yes."

For more information

The National Fire Protection Association's Firewise USA program (firewise.org) offers recommendations for building materials and construction details to reduce the risk of fire.

The California Department of Forestry and Fire Protection (Cal Fire) is the state agency responsible for fire protection and hazard mapping. Its website (calfire.ca.gov) includes information on vegetation management and wildland building codes.

The Insurance Institute for Business and Home Safety (IBHS) has published a series of regional retrofit guides explaining how existing buildings can be fortified against wildfires. Guides can be downloaded for free on their website (disastersafety.org).

Survival Story –Tubbs fire, Mendocino County, CA - Oct. 17

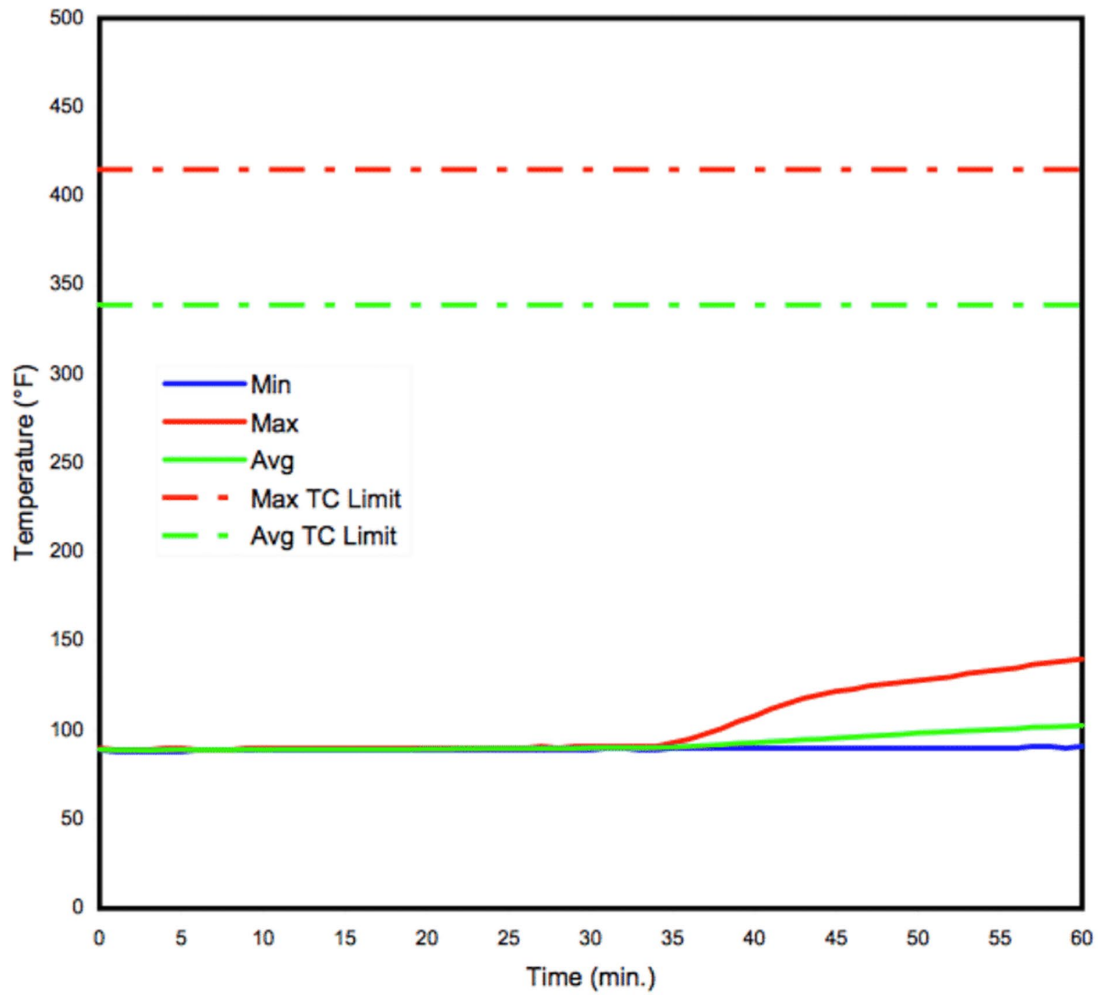
Palomar Mountain Fire (San Diego County)

CARR FIRE – AUG ’18 - Shasta and Trinity Counties, CA

NORRBOM FIRE (NUNS FIRE)– OCT ’17 – Sonoma County, CA

Fire Safety - ASTM Tested for 2 Hour Rated Wall

EBNet
Project No. 3098054B
Min, Avg, Max Cold Side Temperatures



STACKED BENEFITS OF STRAWBALE

- Annually Renewable– By-Product of Grain
- High Insulation Value – R-30 (1.2 – 2.0/in.)
- Thick Walls – Deep Jambs at Openings
- Good IAQ and Humidity Control
- STORES CARBON !
- Acoustic Control
- Structural Integrity
- Excellent Fire Resistance
- Durable and Long Lasting
- Thermal Mass and Time Lag
- User Friendly- Community Building

Derby St. Strawbale ADU, Berkeley, California
Arkin Tilt Architects

Deer Park Monastery

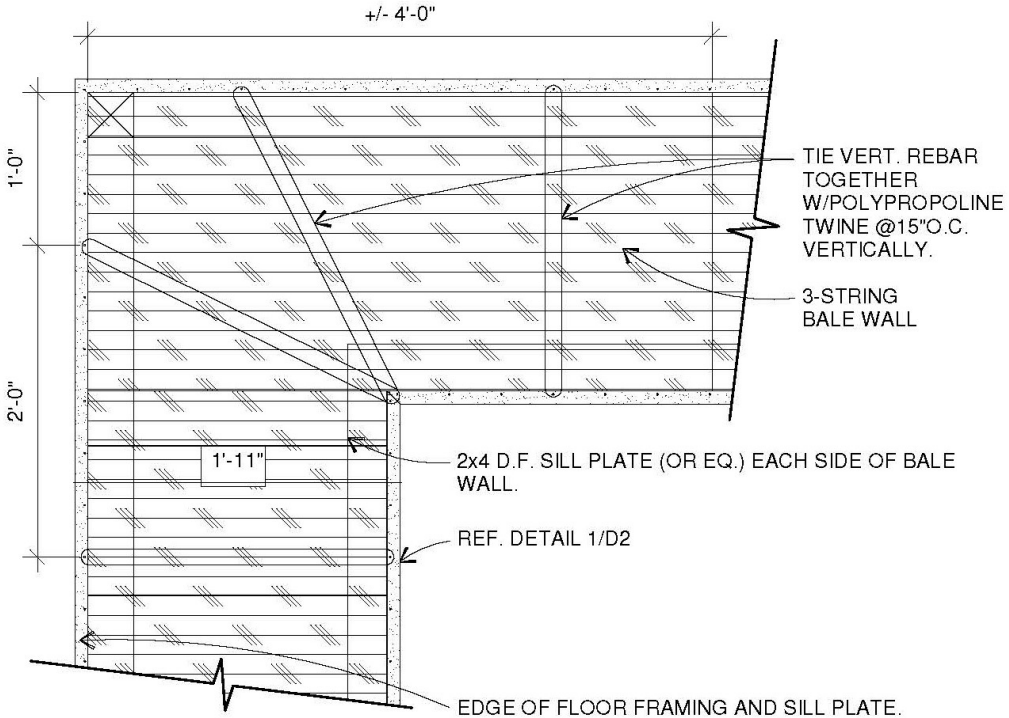
HUBBELL &HUBBELL

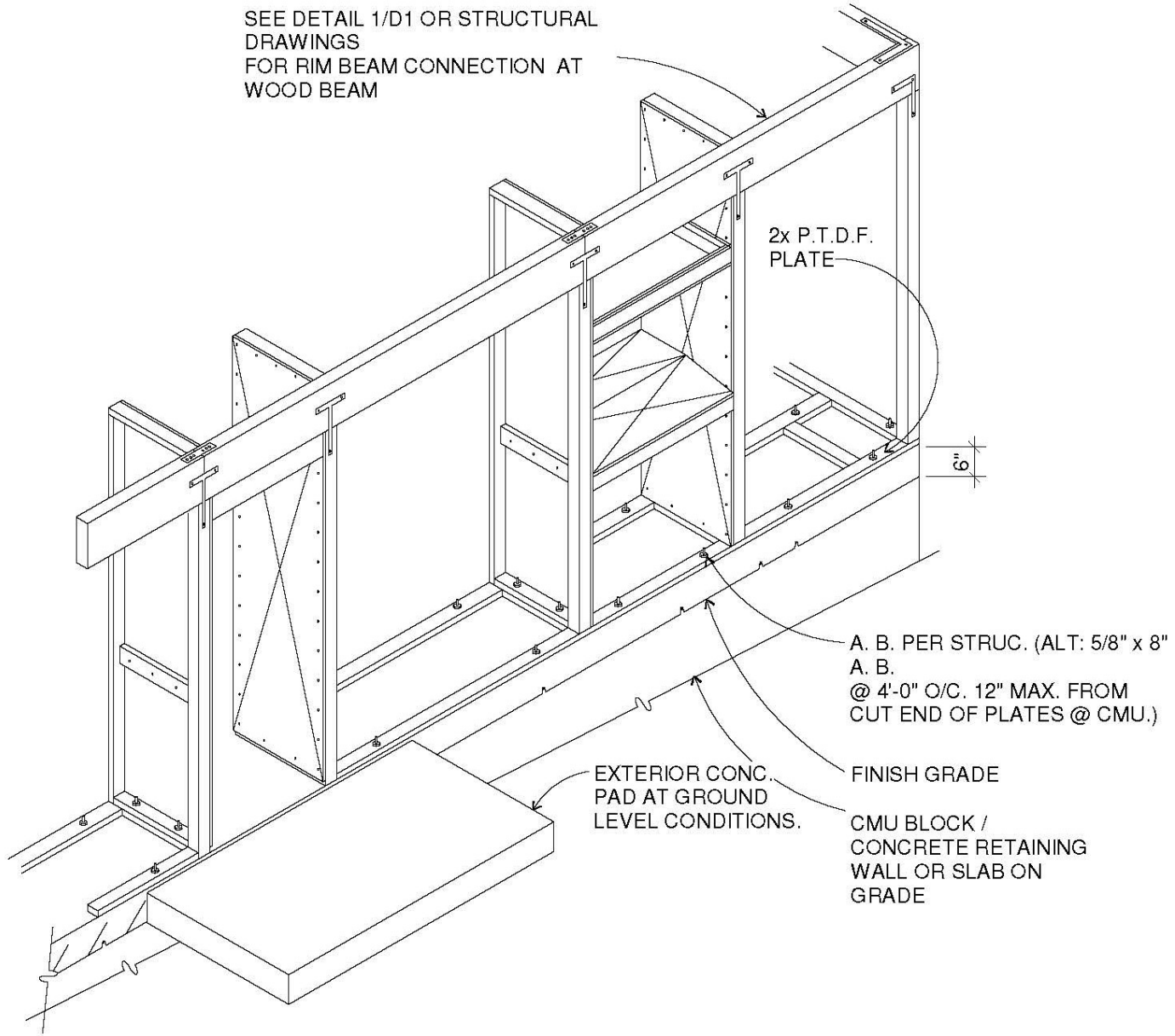
Completed in 2016

Deer Park Monastery

Photos by Arnel Garcia

STRAW BALE CONSTRUCTION DETAILS



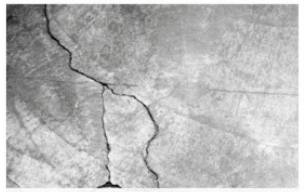


2 TYP. WINDOW/DOOR BUCK
3/8" = 1'-0"

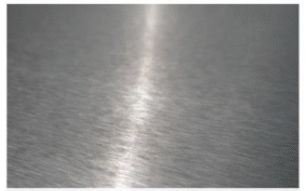
CARBON SMART
MATERIALS PALETTE™

HIGH-IMPACT MATERIALS

Predominant building materials with high-impact potential for emissions reductions



CONCRETE



STEEL

WOOD

INSULATION

CARPET

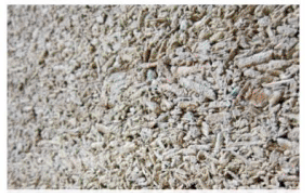
GYPSUM BOARD

CARBON SMART
MATERIALS PALETTE™

CARBON-SMART MATERIALS

Low carbon/carbon sequestering materials

BAMBOO



HEMPCRETE

SHEEP'S WOOL

STRAW-BALE

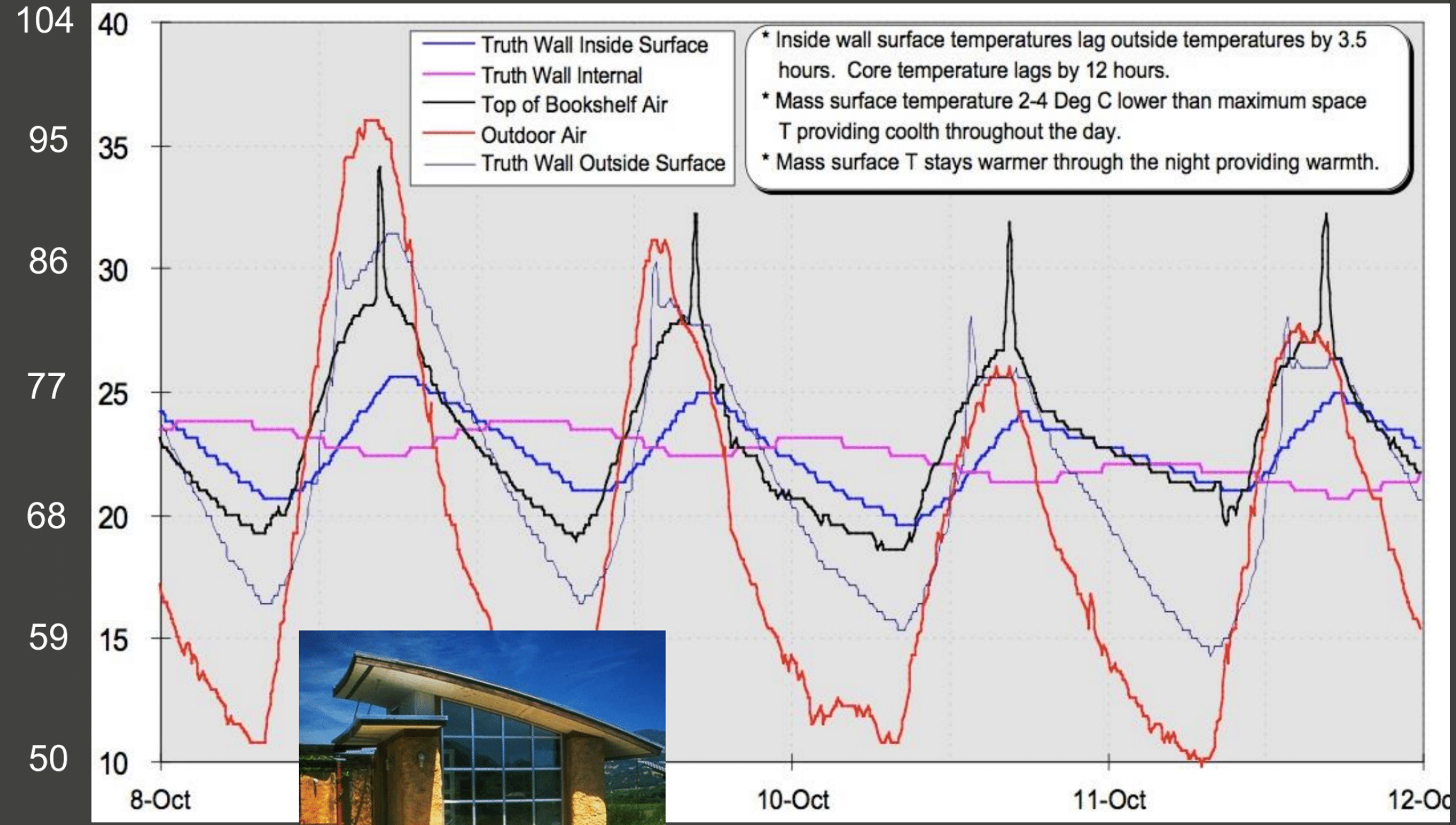
WOOD

www.materialspalette.org

www.carbonleadershipforum.org

2.16 billion tons of grain straw were grown globally in 2016. That's enough carbon storage to **offset all current transportation GHG emissions** and more than **replace all current insulation materials**.

Thermal Mass Effect



Plaster Over Straw Bale

PISE on Strawbale - Tubbs Fire Rebuild, Santa Rosa, CA

EARTHEN PLASTER & LIME PAINT OVER STRAW BALE

Romero Residence 2023
Hubbell & Hubbell

Straw Bale:

2 hour fire-rated wall

24” thick wall

R-30 Insulation

Carbon Storage

Deer Park Monastery

Vs.

Insulated Composite Concrete Block (ICCF):

4 hour fire-rated wall

R-26 Insulation

10” thick wall

FOR MORE INFORMATION:

WEBSITES :

- https://www.hubbellandhubbell.com/portfolio-items/straw-bale
- https://www.strawbuilding.org
- https://www.arkintilt.com/straw-bale
- https://www.naturalplastersandiego.com/posts
- https://simpleconstruct.net/blog/

ARTICLES :

- Grass-Roots Campaign: Earth-Minded Advocates Join Forces to Erect the First Straw Building in an Urban San Diego Neighborhood." Ann Jarmusch. San Diego Union Tribune 20 Nov. 2005:

CODE :

2018 International Residential Code (IRC)

- Appendix S – Strawbale Construction
- Appendix R - Light Straw-Clay Construction

HUBBELL HUBBELL

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