Wildfire Hardened and Energy Efficient Building Assemblies –

Presented by:

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Building Science©

Funded by Energy Codes and Standards
Southern California Edison 2025

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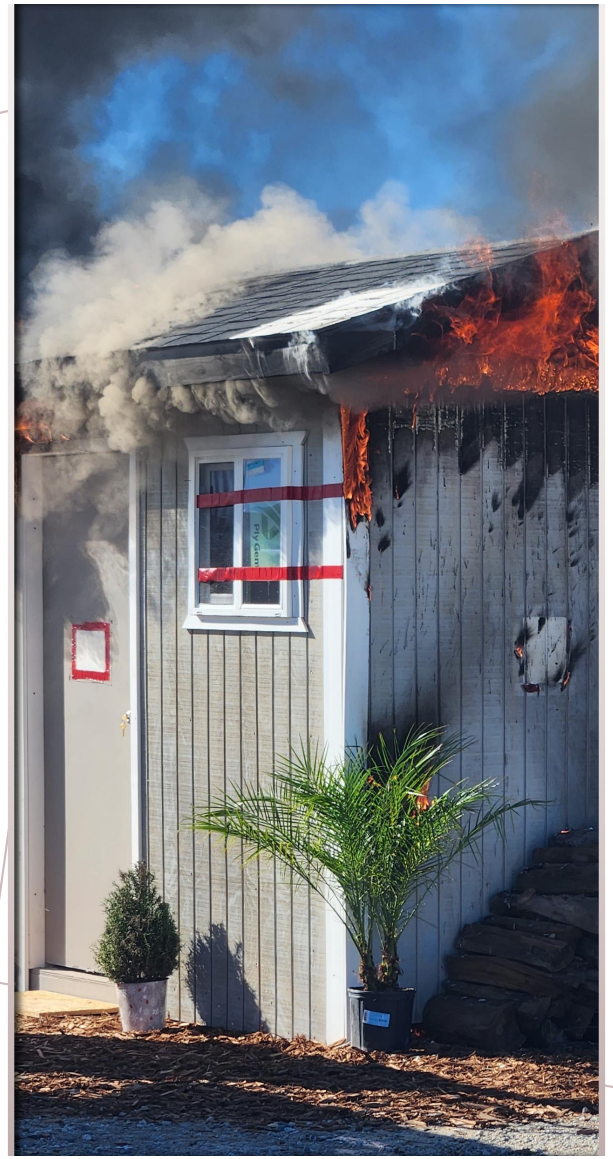


Learning Objectives

1. Burn Test Study (K&A Building Science & SCE)
2. Wildfire Hardened Displays - SCE Energy Education Center
3. Key Points

Learning Objective #1

Burn Test Study

San Bernardino Regional Emergency Training Center Burn Test January 30th, 2024

The Goal of our Burn Test Study

- To test ignition resistant & non-combustible building materials as an advanced framed assembly, in a high-density setting, to stand alone & survive the full duration of a residential fire.
- Structures facing each other, not side by side.

U-Stucco being installed.

Residential Fires

- The average duration = 60 minutes
  - 15 minutes up to 3 hours
- The average temperature = 1,600° F
  - Extreme fuels and winds = 2,000° F

Burn Structure -

- Needs to last 60 minutes
- Produce direct flame & radiant heat exposures of 1,600° F

Burn Structure -

- Conventionally framed 2”x6”x16” o/c
- Open eave
- Vented attic
- Wood siding
- Insulated, drywalled and taped
- No defensible space
- Combustibles in the 0’-5’ zone around the structure

A lot of wood furniture!

- Standard vinyl fence
- Standard metal fence

Hardened Structure -

- Advanced framing 2” x 6” x 24” O.C. (Less fuel)
- Enclosed eave
- Unvented attic
- Non-combustible siding
- Insulated, drywall and taped
- 60-minute fire rated window
- 60-minute fire rated door
- Defensible space – Zone 0 (0’-5’)
- SSD 10’ from neighboring parcel

Non-Combustible Exterior Siding & Roofing

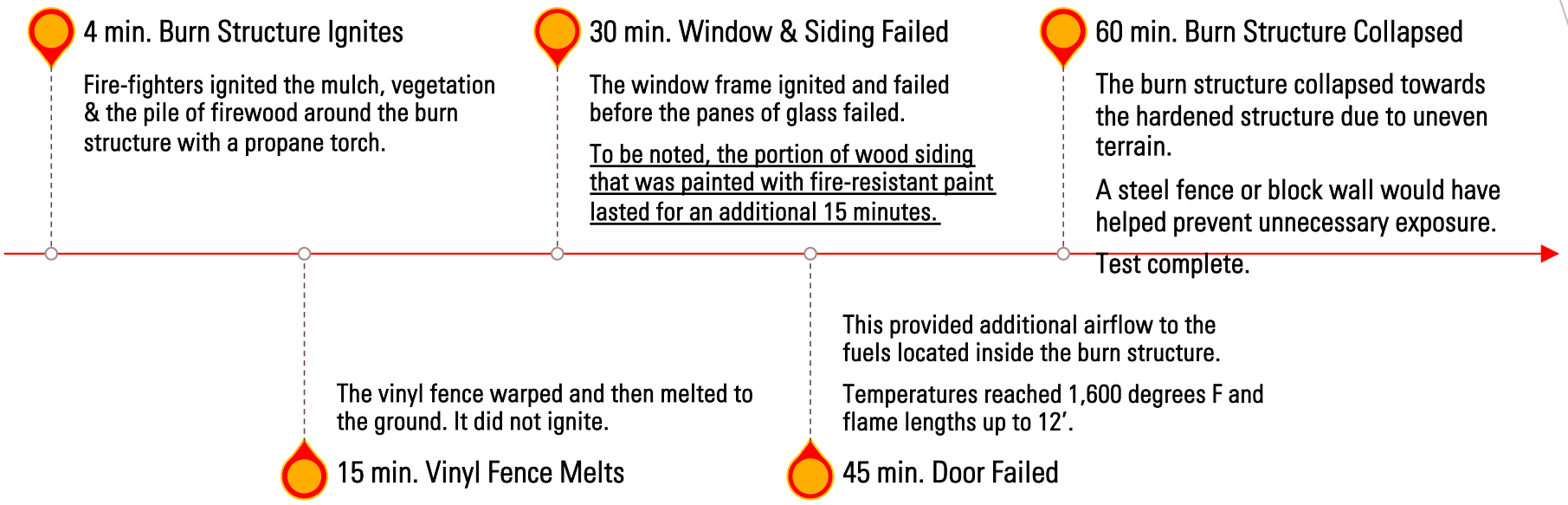
Lathing

U-stucco (R-2): Single Coat (7/8”-1”)

Standard Stucco R-0.20

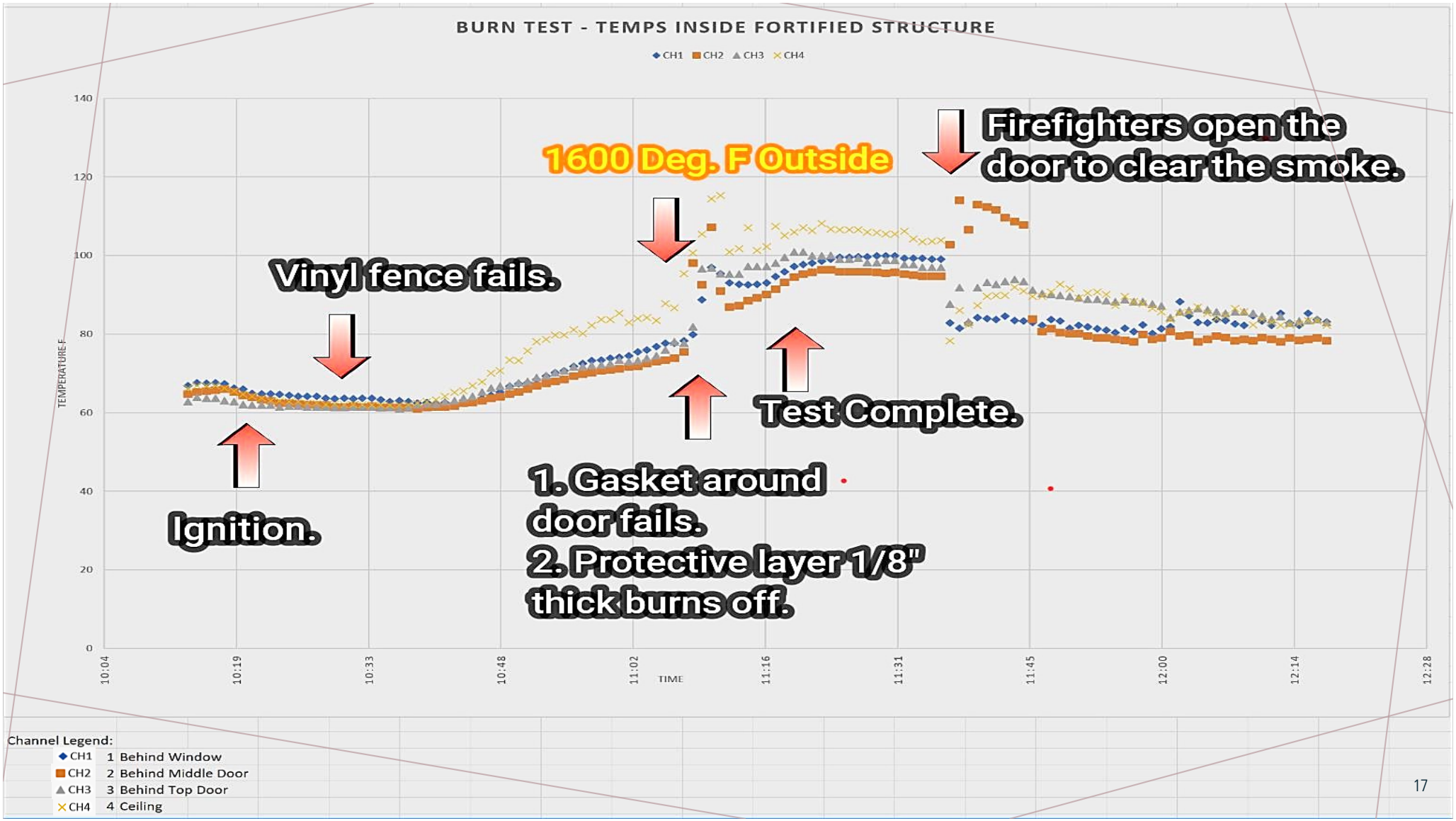
FR-Clear Coating or Paint: Red Taped Sections

Burn Structure Timeline



Video: Kliewer and Associates performs Burn Test for SCE

https://youtu.be/VJKS_qSk9P4?si=eJ2hNJUi3e8pp1jU


BURN TEST - TEMPS INSIDE FORTIFIED STRUCTURE
CH1 CH2 CH3 CH4
TEMPERATURE F
TIME
1600 Deg. F Outside
Firefighters open the door to clear the smoke.
Vinyl fence fails.
Test Complete.
Ignition.
1. Gasket around door fails.
2. Protective layer 1/8" thick burns off.
Channel Legend:
CH1 1 Behind Window
CH2 2 Behind Middle Door
CH3 3 Behind Top Door
CH4 4 Ceiling

Vinyl fence melts and does not sustain flame.

FR-Paint & Coating

FR-paint provided 15 minutes of protection.

Neither are approved in California building codes.

We Did Not Anticipate

- The burn structure collapsing towards the hardened structure.
- Building materials may have to withstand impact.
- Steel fence or a concrete block wall.
- Wildfire events may have extremely high winds and debris that may fall onto or against your structures.

Design met the anticipated exposure

- Advanced framing 2” x 6” x 24” O.C. (Less fuel)
- Enclosed eave
- Unvented attic
- Ignition resistant and non-combustible siding
- Insulated, drywall and taped
- 60-minute fire rated window
- 60-minute fire rated door
- Defensible space
- SSD 10’ from neighboring parcel

Forensic Study

1/8” Layer on the 60min. FR-Door Contributes to Direct-Flame Exposure to the Closed Eave.

Observations

- Eaves trap heat.
- Extremely vulnerable to ignition.
- Relatively easy to enclose with non-combustible materials.

Recommendations

- If attics are vented, use ember and fire-rated vents with 1/16”-1/8” openings. Options may include:
  - Stainless steel wire (looks like steel wool).
  - Intumescent firestop materials; Expands when heated which closes the screened openings preventing ember and direct flame exposure.
  - Replaceable cartridge design.
  - Metal louvers over the screen mesh prevents the screen mesh being painted over.

60-Minute Fire Rated Door

1/8-inch layer burned off.

Non-Combustible Core

Heat Transfer at the Hinges

Concentrated heat at the door hinges.

Critical Information

Fiber cement & drywall withstood heat transfer.

Wood stud was scorched at steel hinge.

Recommendations

- Ensure the steel door frame is installed over noncombustible materials such as drywall or fiber cement board.
- Use thermal breaks to prevent heat transfer.
- Caulk any gaps with fire rated caulking or intumescent materials in through-hole penetrations.

Door Recommendations

- 60–120-minute fire-rated door.
  - Highest rating possible when fuel or structure exposures are less than 30’ (High-density).
- Must include the equivalent rated door jamb & weather stripping.
  - If steel, install ¼” fiber cement board between the steel door jamb and wood framing.

Non-Combustible Siding/Roof: U-Stucco

No damage to wood sheathing or underlayment

Heat did not transfer through U-Stucco

SAFTI*FIRST* 60min. Fire Rated Window

Superlite II-XL

Intumescent Interlayer Expands

SAFTI*FIRST* 60min. Fire Rated Window

Appears the gypsum pack plastic coating heated up enough to stick to the steel tubing

Wood framing undamaged

Conclusion – Hardening and Defensible Space Provides:

- Additional time for residents to escape
- More time for first responders to arrive
- A safer working environment for first responders to defend the structure
- Evidence that structures can be designed to stand-alone against wildfires

Recent 2025 Palisades Fire

Chasen Architect – Greg Chasen AIA

Learning Objective 2:
Southern California Edison Energy Education Center
Wildfire Hardened Module Pullouts

6090 Irwindale Ave, Irwindale, CA 91702
800-336-2822

SCE Building Envelope Classroom – Wildfire Hardened Pull-Out Modules and How to Meet T24 Part 7 2025 California Wildland-Urban Interface Code

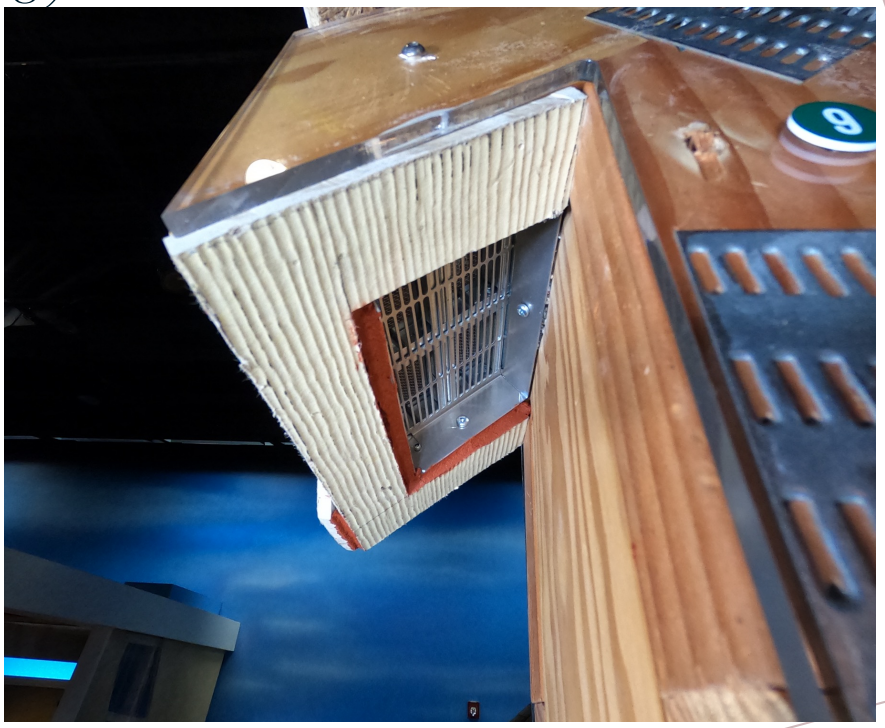

MODULE #3
ROOF
THICKNESS
R-VALUE
FIRE RATING
1 Concrete Roof Tiles (w/bird stops) 1" 0.08 Class A
2 O'Hagin Fire & Ice Vent 26 Guage N/A ASTM E2886
3 2 layers of 30lb underlayment 1.2mm 0.12
4 LP Flame-block Sheathing 7/16" 0.55 ASTM E84/UL 723
5 Drip edge steel flashing 26 Gauge N/A Noncombustible
6 Fascia fiber cement siding 1/4" 0.13 ASTM E84/E136/C177
7 Fire rated caulking smoke seal ASTM E814 (UL1479)
WALL
8 Raised-heel truss 24" On Center N/A
9 Open cell spray foam 10.55" 38 Class 1
10 2x6 single top plate 1.5" x 5.5" 5.5"
11 3x6 framing connector 20 Guage N/A
12 Drywall 0.5" 0.45 ASTM E136/E-84
13 Inside Air Film 0.68
14 Drywall backing clips 0
15 2x6 studs @24" on center 1.5" x 5.5" 5.5
16 2-stud corner 5.5
17 Open cell spray foam 5.5" 19.8 Class 1
18 OSB shear panel 7/16" 0.51
19 Weather Resistant Barrier (WRB) – Tyvek 0.0087" 2 Class A
20 Insulating Fireproof U-Stucco 7/8" 2 Class 1
21 Safti-First Superlite II-XL 60min. FR Glazing 1-7/8" Low-E 1.14 ASTM E119/NFPA 251
22 Steel Frame N/A
23 Mineral Wool 2" 8.4
24 Gypsum Core/ Aluminum Cap Not Rated
25 Slab on grade (simulated) N/A
IWUIC - IGNITION RESISTANT CONSTRUCTION CLASS 1
ROOF FRAMING FACTOR 6.8%
ROOF ASSEMBLY U-VALUE 0.026
WALL FRAMING FACTOR 17%
WALL ASSEMBLY U-VALUE 0.044

Roof Framing Factor 6.8%
Roof Assembly U-Value 0.026 (2025 Code Attic Space 0.043, Unvented Attic 0.075)
Roof Assembly R-Value 38 (2025 Code R-22, Cathedral Ceilings R-38)

Wall Framing Factor 17%
Wall Assembly U-Value 0.044 (2025 Code 2"x6" 0.069)
Wall Assembly R-Value 25.9 (2025 Code 2"x6" R-21)


MODULE #6
ROOF
THICKNESS
R-VALUE
FIRE RATING
1 Concrete roof tiles (Incl battens & air space) 2" 2.95 Class A
2 SOL-R-SKIN FR-underlayment 1/8" 5.5 ASTM E108
3 72lb Mineral surfaced cap sheet 1/8" 0.34 UL Listed Type G3 Capsheet
4 Rockwool mineral wool insulation board 1" 4.2 Class A/ASTM E84/UL 723
5 LP Flame-block sheathing 7/16" 0.55 ASTM E84/UL 723
6 Drip edge steel flashing 26 Gauge Noncombustible
7 Fascia fiber cement siding 1/4" 0.13 ASTM E84/E136/C177
8 Ember & fire rated vent 2.13" Intumescent Vent
9 Engineered raised-heel truss
10 Blown-in Cellulose (R3.1/in) 12.25" 38 Class 1
WALL
11 2x6 single top plate 1.5"x 5.5" 5.5
12 2x6 studs @24" on center 5.5"
13 Optimum Window 60min. FR Glazing 1-7/8" Low-E Not Rated
14 Air Seal Plumbing and Wiring Penetrations N/A
15 Rockwool mineral wool batts 5.5" 22 Class A/ASTM E84/UL 723
16 Gypsum wall board 1/2" 0.45
17 OSB sheathing 7/16" 0.51
18 Weather Resistant Barrier (WRB) – Tyvek 0.0087" 2 Class A
19 Rockwool mineral wool insulation board 1" 4.2 Class A/ASTM E84/UL 723
20 Fiber cement vertical siding 1/4" 0.13
21 Fiber cement batten trim 3/4" N/A
22 Galvanized steel Z bar flashing 26 Gauge Noncombustible
23 Fiber cement lap siding 1/4" 0.13
24 Galvanized steel 6" flashing 26 Gauge Noncombustible
25 Ceramic tile N/A
26 Inside Air Film 0.68
27 15lb felt paper 1/16" 0.06
28 Slab on grade (simulated) N/A
IWUIC - IGNITION RESISTANT CONSTRUCTION CLASS 3 *
*Remove the eave vent = Class 1
ROOF FRAMING FACTOR 6.8%
ROOF ASSEMBLY U-VALUE 0.020
WALL FRAMING FACTOR 17%
WALL ASSEMBLY U-VALUE 0.035

Roof Framing Factor 6.8%
Roof Assembly U-Value 0.020 (2025 Code Attic Space 0.043, Unvented Attic 0.075)
Roof Assembly R-Value 49.9 (2025 Code R-22, Cathedral Ceilings R-38)



Wall Framing Factor 17%
Wall Assembly U-Value 0.035 (2025 Code 2"x6" 0.069)
Wall Assembly R-Value 25.9 (2025 Code 2"x6" R-21)

Fenestration

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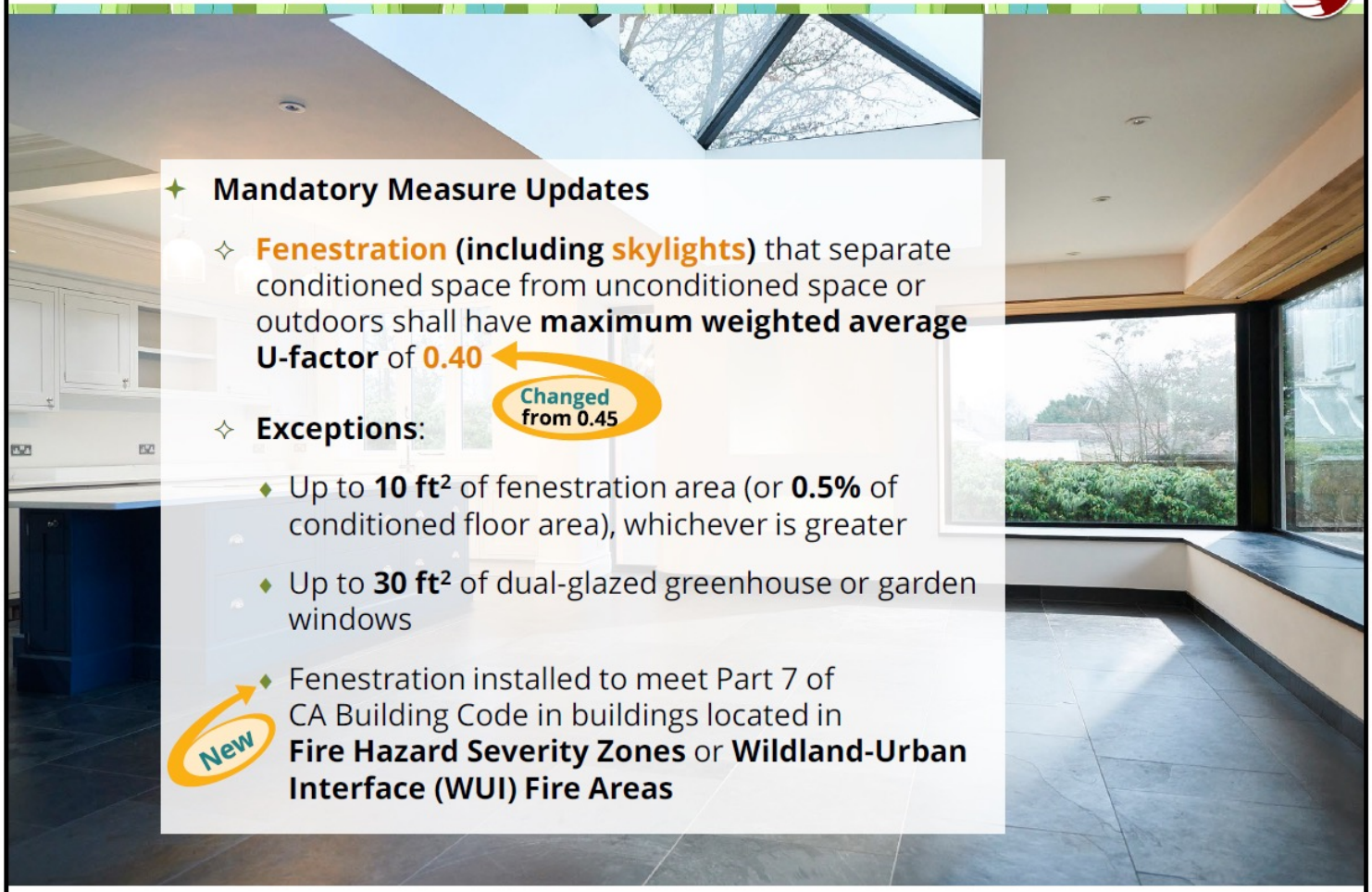

- **Mandatory Measure Updates**
  - **Fenestration (including skylights)** that separate conditioned space from unconditioned space or outdoors shall have **maximum weighted average U-factor** of **0.40**

    Changed from 0.45
  - **Exceptions**:
    - Up to **10 ft²** of fenestration area (or **0.5%** of conditioned floor area), whichever is greater
    - Up to **30 ft²** of dual-glazed greenhouse or garden windows
    - Fenestration installed to meet Part 7 of CA Building Code in buildings located in **Fire Hazard Severity Zones** or **Wildland-Urban Interface (WUI) Fire Areas**

New

Key Points

- Successful hardening against embers, direct flame, radiant heat and convection includes:
  - Defensible space
  - Non-combustible materials for high-density settings <30’
  - 1hr minimum ignition-resistant materials >30’
  - Prevent thermal bridging:
    - Metal contacting wood framing
    - Advanced framing (less lumber)
  - Enclosing the eaves as they trap heat (w/non-combustible materials)
  - Sealing gaps

Key Points

- Energy Efficiency gains are realized from:
  - Air sealing
  - Proper sealing around fire-rated doors and windows
  - Advanced framing
  - Non-combustible or ignition-resistant thermal barriers added to:
    - Roof decks
    - Exterior sheathing/siding


Q&A

Pushing the Building Envelope

Energy Research: Efficiency/ Demand Response

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"Good buildings *aren't an accident;* they happen by design" -Joe Lstiburek

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