Efficient Building Materials & Safety

January 17, 2023

Edward Louie
Building Energy Efficiency Research Engineer
Overview

Retrofit safely:
- Asbestos
- Lead paint
- Knob and tube wiring
- Backdraft

New(ish) Building Materials and Their Safety
- Foams (spray foam, rigid foam)
- Structural Insulated Panel (SIP)
- Insulated Concrete Form (ICF)
- Air sealing, compartmentalization, smoke & fire safety
Retrofit Safety - Asbestos

Removal of the old existing hazardous materials may be the most expensive and risky part of the retrofit

Asbestos

- OSHA Class I asbestos work – Applies to removal of asbestos containing thermal system insulation (loose, batt, sprayed-on, troweled-on insulation) – structural insulation AND pipe, tanks, ducts.

- PPE, health monitoring, negative air; EPA disposal rules.

- Regulations silent on protecting occupants and furnishings during clean up – homeowners, protect yourself with common sense!
Retrofit Safety – Lead Paint

Removal of the old existing hazardous materials may be the most expensive and risky part of the retrofit

Lead Paint

EPA’s Lead renovation, repair, or painting (RRP) rules. Lead-Safe Certified firm.

- Removal of interior wall coverings with lead paint during gut remodel
- Removal of exterior wall coverings with lead paint during insulation upon residing
- Consider encapsulating rather than removal
Retrofit Safety – Knob & Tube Wiring

Removal of the old existing hazardous materials may be the most expensive and risky part of the retrofit

Knob & Tube Wiring

• There is no safety code that mandates its complete removal
• Best time to replace: insulation upgrades, if homeowners insurance won’t cover your home due to the old wiring
• K&T wiring is cooled by air, burying it in insulation will cause it to overheat
Retrofit Safety – Back Drafts

• Air sealing a home with natural draft combustion appliances in the conditioned envelope may result in these appliances back drafting

• Test for back draft before and after air sealing and insulation under worst case depressurization conditions

• Remediate back draft if found
Foams – Fire Safe but Environmentally Unfriendly Flame Retardants

Section 2603.3 of the IBC defines maximum flame spread and smoke developed index limits for a foam plastic to be used in commercial construction: Flame Spread less than 75, Smoke Developed less than 450 under ASTM E84 test. Exterior Walls (Section 2603.5.4) places more stringent requirements on foam plastics: a flame spread of less than 25 and a smoke developed of less than 450.

IBC section 2603.4 and 2603.5.2 stipulate that foam plastic insulation must be separated from the interior of a building by a thermal barrier (typically 1/2 inch gypsum). However, if a particular foam plastic has passed the appropriate fire test (such as UL 1715, Fire Test of Interior Finish Material, or NFPA 285, Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth) it can be left exposed to the interior of the building.

Are flame retardants necessary for homes when the foam will be protected by drywall?

ASTM/UL/NFPA is not in the business of long-term human health or long-term environmental testing.
Structural Insulated Panel (SIPs)

- EPS panels are always treated with flame retardants
- Interior gypsum and exterior non-combustible siding essential for rounding out the fire safety
- No chimney effect in the walls as found in a stick-built structure

<table>
<thead>
<tr>
<th>IRC requirement</th>
<th>Referenced standard</th>
<th>Test method(s)</th>
<th>Acceptance criteria</th>
</tr>
</thead>
</table>
| SIPS shall comply with requirements of ANSI/APA PRS 610.1 | ANSI/APA PRS 610.1 | ASTM E84 or UL 723 Standard for test for surface burning characteristics of building materials | For SIPS with core materials excluding foam plastics:  
  - Core material must have a flame spread index ≤75 and smoke-developed index ≤450 when tested in accordance with ASTM E84 or UL 723 at 4 inches thickness.  
  - For SIPS with foam plastic insulation ≤4 inches (102 mm) thick:  
    - Flame spread index ≤75 and smoke developed index ≤450 when tested in the maximum thickness and density intended for use in accordance with ASTM E84 or UL 723. |
| Foam plastics shall be separated by an approved thermal barrier (IRC section 316.4 for foam plastics) | NFPA 275 | Temperature transmission fire test |  
  - During the 15-minute test period, the average measured temperature rise of the thermocouples shall not exceed 250°F (139°C).  
  - The measured temperature rise of any single thermocouple shall not exceed 325°F (181°C). |
| Integrity fire test (in accordance with one of:  
  - NFPA 286 Standard methods of fire tests for evaluating contribution of wall and ceiling interior finish to room fire growth  
  - FM Approvals 4880  
  - UL 1040 Fire test of insulated wall construction  
  - UL 1715 Fire test of interior finish material) | Conditions of acceptance for tests conducted in accordance with FM Approvals 4880, UL 1040 or UL 1715 shall be as specified in the standard used.  
  - For tests conducted in accordance with NFPA 286, the following acceptance criteria apply:  
    - No flame spread to the ceiling during 40 kW fire exposure.  
    - No flame spread to the outer extremity of the test assembly on any wall or ceiling.  
    - Flashover shall not occur.  
    - Peak heat release rate shall not exceed 800 kW.  
    - Total smoke released shall not exceed 100 m². |
Insulated Concrete Form (ICF)

- ICF walls generally have a 4-hour fire rating
- “The flames travel about one-fifth as far down a tunnel lined with ICF foams as they spread down a tunnel lined with wood”
- EPS treated with flame retardants don’t contribute fuel to the fire
Air sealing, Compartmentalization, Smoke & Fire Safety

• Multifamily safety improvements due to air sealing for energy efficiency – better compartmentalization
Nexus of Energy Efficient Materials, Designs and Disaster Resistance

• PNNL’s Building America Solution Center has resources to help builders balance and design homes so they are both disaster resilient and energy efficient.

https://basc.pnnl.gov/disaster-resistance
Questions

edward.louie@pnnl.gov
Thank you