Wall System Innovation

Familiar Materials

Better Performance

Vladimir Kochkin
Joseph Wiehagen

April 2013

Home Innovation RESEARCH LABS™

Building AMERICA® U.S. Department of Energy

Wall Innovation Metrics

- High R (thermal and air barrier)
- High Performance
  - Durable, structural
- Build-able
- Low transition risk to builders
- 50% Building America Goal
- ≈ R25+ (CZ 4 and higher)

Home Innovation RESEARCH LABS™

Background

- Technologies for high-R walls have been proposed and used for over 25 years
- But real market penetration is very low
- Often the last EE measure implemented by builders (e.g. E*)

Home Innovation RESEARCH LABS™

Background

- High-R wall solutions have not achieved a broad level of standardization and commonality
  - A large set of methods and materials entered the market
  - Multiple and conflicting details
- Wall characteristics are more critical = RISK

Home Innovation RESEARCH LABS™

New Home Starts – Wall Framing

FRAMING	2001	2006	2011
2x4 @ 16” o.c.	74%	73%	57%
2x4 @ 24” o.c.	2%	3%	4%
2x6 @ 16” o.c.	22%	22%	32%
2x6 @ 24” o.c.	2%	2%	6%
Other	1%	0%	1%
TOTAL	100%	100%	100%

Home Innovation RESEARCH LABS™

New Home Starts – Wall Sheathing

FRAMING	2001	2006	2011
None (concrete, SIPs or others)	10%	12%	9%
WSP (Plywood, OSB, ZIP)	65%	68%	80%
1/2 inch fiberboard	3%	3%	<1%
1/8 inch (Thermoply, EnergyBrace)	3%	2%	3%
SIS	n/a	n/a	1%
Foam (XPS, EPS, ISO)	17%	12%	5%
Other	3%	4%	0%
TOTAL	100%	100%	100%

Home Innovation RESEARCH LABS™

New Home Starts

Oversheathing

Oversheathing	2006	2011
Shares of Homes with 2nd Layer of Foam Sheathing	7%	9%

Housewrap

Housewrap	2006	2011
Homes with housewrap	54%	75%

Home Innovation RESEARCH LABS™

New Home Starts – Cavity Insulation

FRAMING	2006	2011
Fiberglass batt	76%	68%
Fiberglass blown	7%	8%
Spray foam	3%	11%
Cellulose	11%	8%
Other or none	3%	5%
TOTAL	100%	100%

Home Innovation RESEARCH LABS™

Increasing Wall Insulation

- When builders are asked how would they go about increasing the wall R-value
  - About 60% say they would use 2x6 or increase the cavity R-value
  - Less than 15% say they would use exterior foam

Home Innovation RESEARCH LABS™

Barriers to Adoption

- "Devil is in the details"
  - Claddings
  - Windows
  - Trim
  - Vapor retarder
  - Framing layout
  - Attachments/ connections
  - Drainage plane
  - Air barriers
  - Etc etc etc

Home Innovation RESEARCH LABS™

Vision for a Wall Construction Guide

Provide practical (and preferred) solutions for high-performance walls

(1) can be readily implemented in the field using available methods and materials

(2) can withstand the test of time from environmental and structural loads

(3) grounded in research and testing

Home Innovation RESEARCH LABS™

Guide Format

- Builder-focused and graphics-rich
  - Application (climate zone)
  - Wall Systems (preferred solutions, not concepts)
  - Details
  - Material characteristics
  - High-R options
  - Integration
  - “Hot spots”

Home Innovation RESEARCH LABS™

Current High-R Options

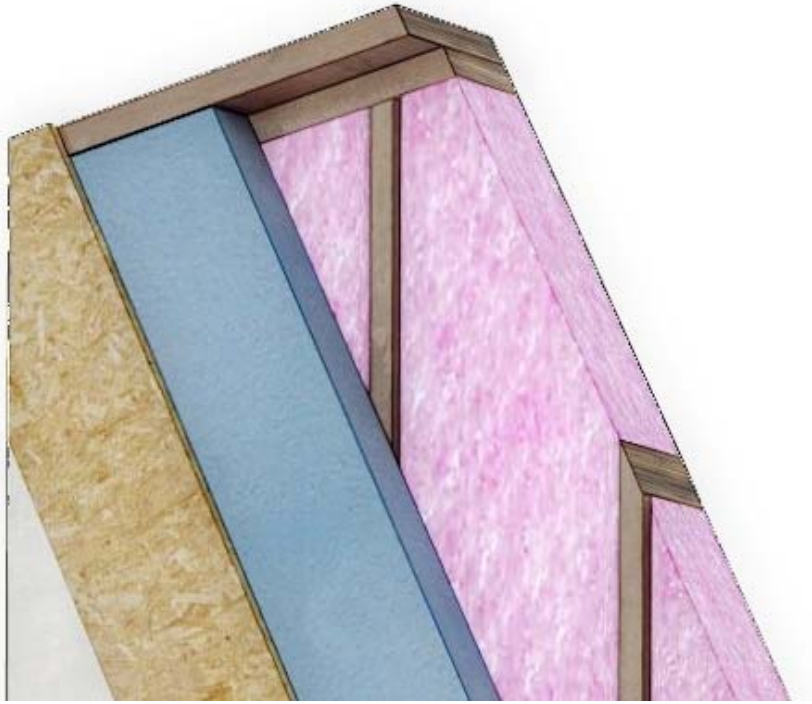
- Deeper cavity
  - Thermal bridging limitation
  - R-value limit
  - Practical wall thickness limit
- Ext Rigid Insul.
  - OSB behind foam
  - Cladding attachments
  - Foam attachment
  - Windows
  - Drainage plane
  - Panelization

Home Innovation RESEARCH LABS™

Is there another way?

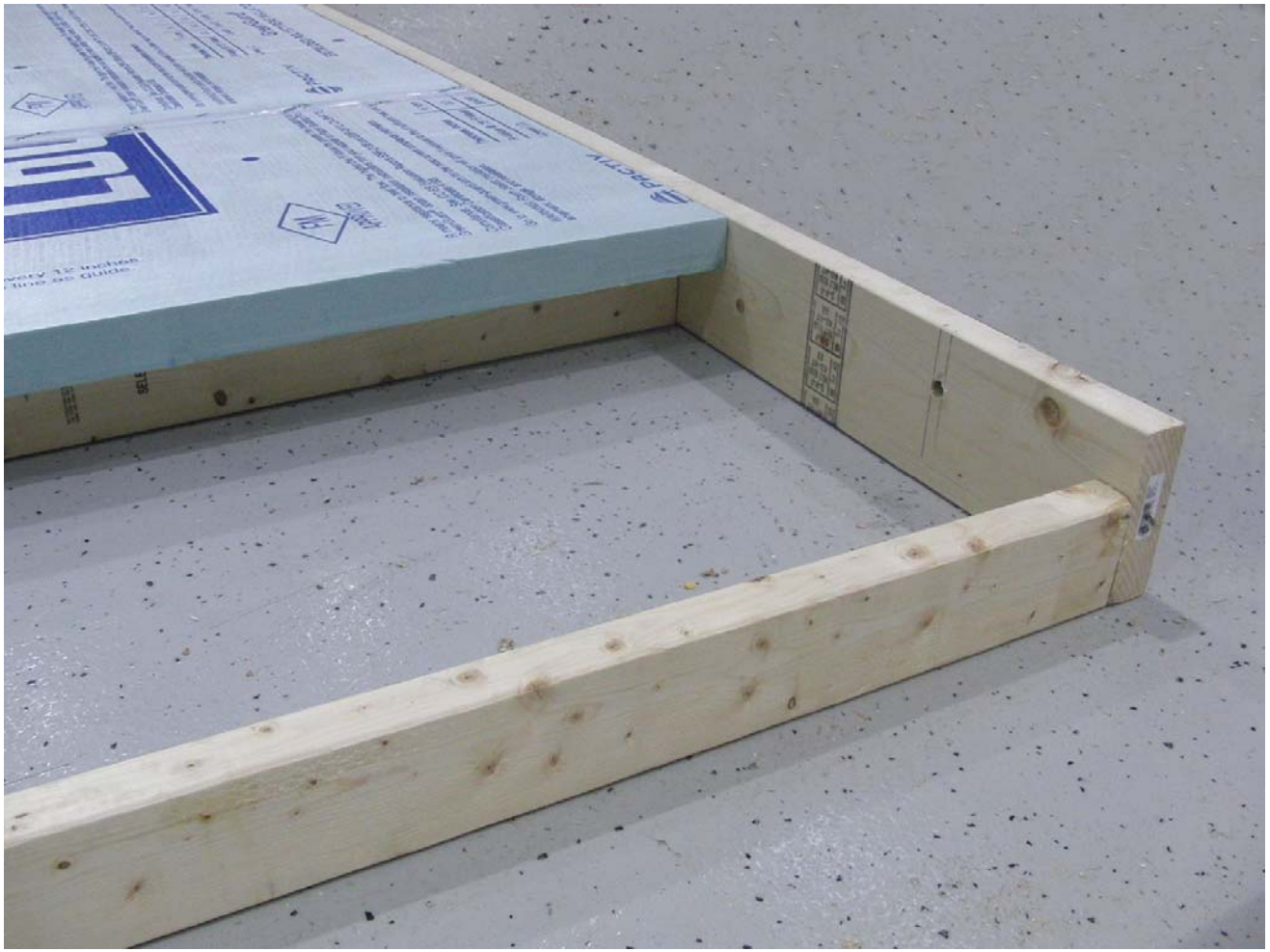
- Hybrid: ***Extended Plate & Beam System***
  - R25+
  - Off-the-shelf materials
  - Standard cavity (2x4 or 2x6)
  - OSB on the exterior, so is drainage plane
  - Standard window installation
  - Integrated rigid foam insulation
  - Site-built or panelized
  - Rim headers integral part of the system

Extended Plate & Beam



- Plates and studs are different width
- R25 (2x4 studs & 2x6 plates)
- R30 (2x6 studs & 2x8 plates)

Mock-up Wall

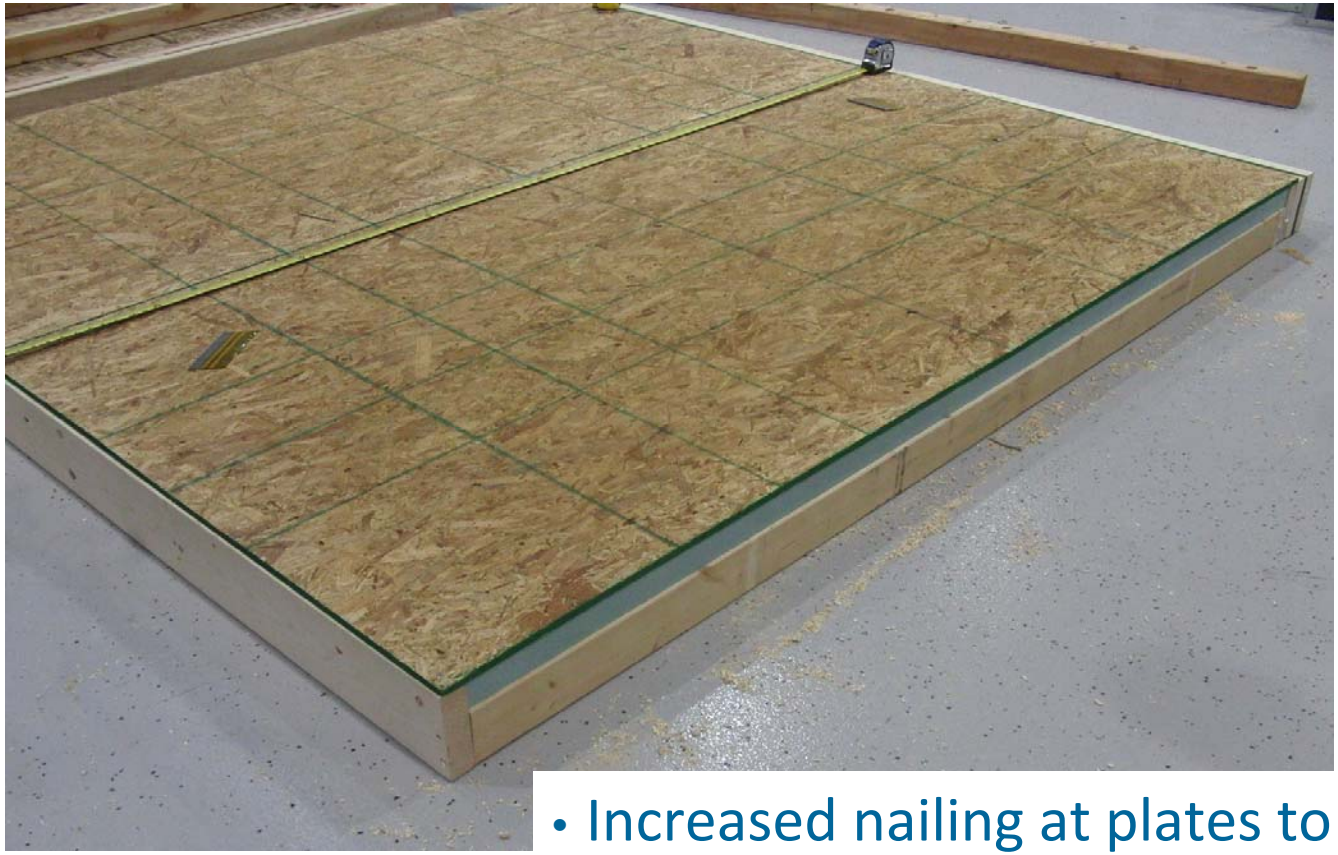


Home Innovation RESEARCH LABS™

2-inch Rigid Foam

Home Innovation RESEARCH LABS™

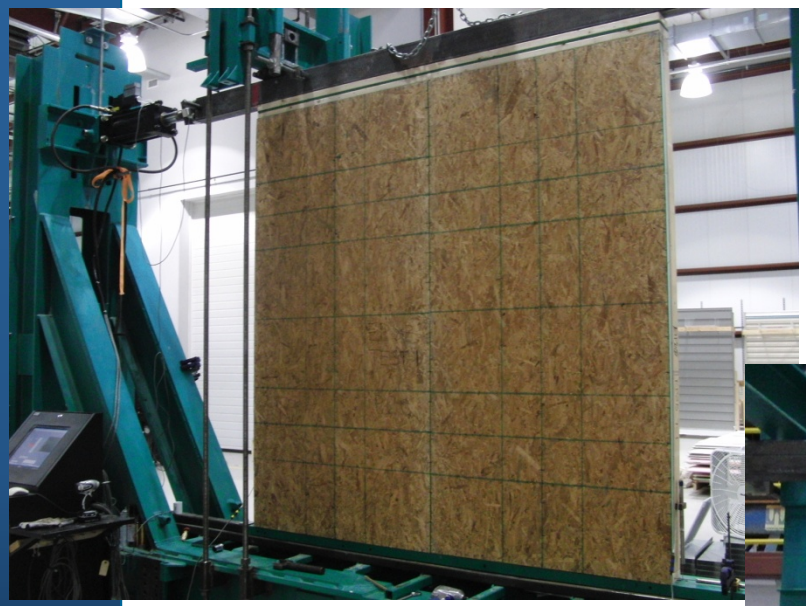
Exterior OSB



- Increased nailing at plates to offset weaker nails in the panel field

Home Innovation RESEARCH LABS™

Initial Shear Wall Testing

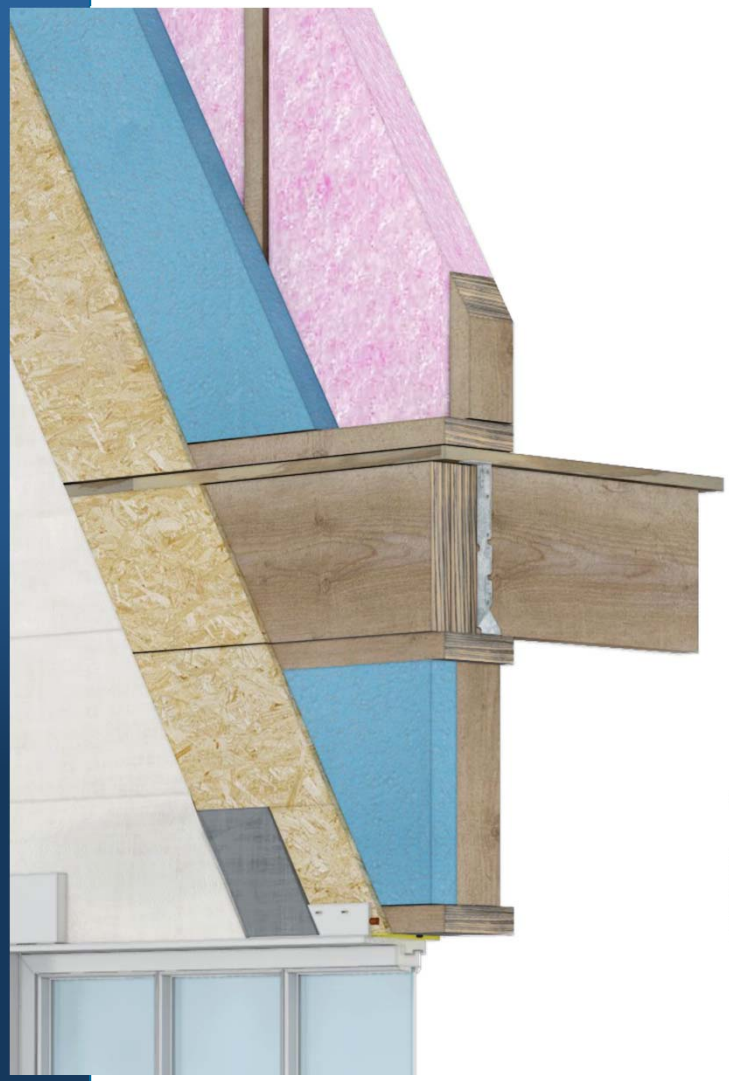


Equivalent to IRC 6”oc nail spacing

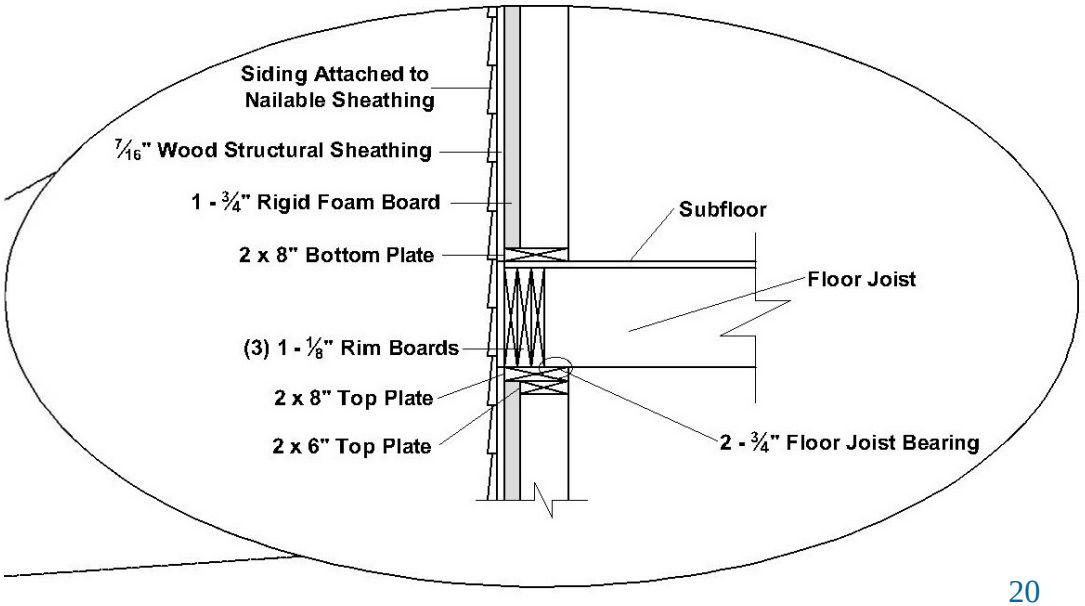
Response mode = typical wood wall

Home Innovation RESEARCH LABS™

Multi-ply rim header (beam)



Header built into the floor



Home Innovation RESEARCH LABS™

Moisture Performance

- WUFI Simulations by Sam Glass (FPL)
  - Baltimore, Chicago, Minneapolis
  - **2x4**s&**2x6**p, **2x6**s&**2x8**p
  - OSB uncoupled from cavity by foam
  - OSB MC fluctuates with seasons and depends on cladding but always below 20%
  - For walls without a vapor retarder, cavity RH higher in very cold climates

Home Innovation RESEARCH LABS™

EP&B Summary

- Developed for R25+ walls
- Structural sheathing on the exterior
- Foam sheathing to exterior of studs
- Window placement and drainage plane standard methods
- Rim header sufficient span most openings
- Warm Cavity

EP&B Summary (cont'd)

- Same construction methodology for R25 and R30 options
- Under development
  - Siding attachment
  - OSB and plate attachment
  - Window and door installation
  - Rim header: lumber, EWP
  - Moisture management
  - Additional shear wall testing

Home Innovation RESEARCH LABS™

EP&B Summary (cont'd)

- Field-framed or panelized
- Standard construction details
- Durable by design

= Simplified transition from conventional framing options

Home Innovation RESEARCH LABS™