Kohta Ueno

Historic Preservation Meets Building Science: The Mallett Deep Energy Retrofit

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BUILDINGENERGY 13
CONFERENCE + TRADE SHOW FOR RENEWABLE ENERGY AND GREEN BUILDING PROFESSIONALS

Overview

The Mallett Deep Energy Retrofit

- The design decision process for how the team chose assemblies and details
- Energy efficiency, durability, constructability

Image c/o Energy Circle

R-Value Targets

Climate Zone	Wall	Vented Attic	Compact Roof	Basement Wall	Exposed floor	Slab edge[1]	Windows (U/SHGC)	Sub-slab[2]
1	10	40	35	5	10	none	yes	none
2	15	50	40	10	20	5	0.35/<.25	none
3	20	50	45	10	20	7.5	0.30/<.3	5
4	25	60	45	15	30	7.5	0.30/<.35	7.5
5	30	65	50	15	30	10	0.24/<.50	7.5
6	35	75	60	20	40	10	0.18/--	10
7	40	90	65	25	45	15	0.15/--	15
8	50	100	75	35	50	20	0.15/--	20

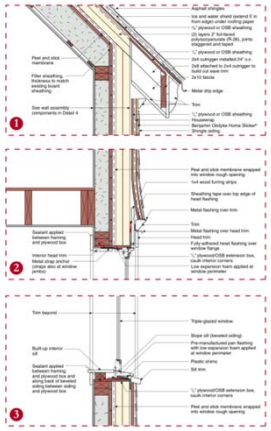
Table 2: Current Recommended "True" Minimum R-value (+/-)[3] including thermal bridging
Source: RR-1005: High R-Value Enclosures for High Performance Residential Buildings in All Climate Zones

- "True" R value: R-13 2x4 wall ≈ **R-8**
  R-19 2x6 wall ≈ **R-12**
- Estimated targets—will vary with local construction costs, energy costs, client targets

Enclosure Design

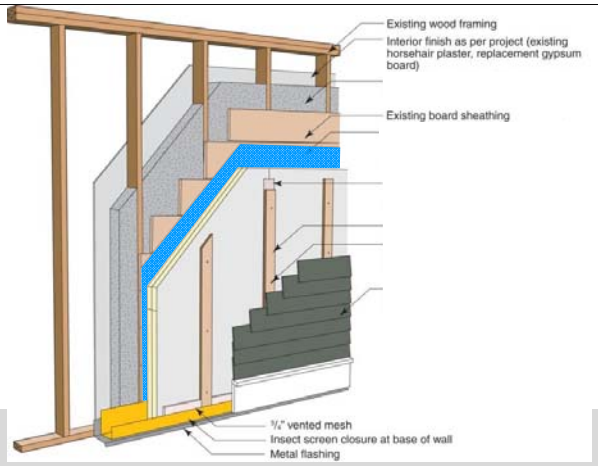
Enclosure Design (1 of 2)

- R-40 Walls
  (existing 2x4 framing filled with cellulose insulation and (2) 2" layers foil-faced polyisocyanurate insulating sheathing on wall sheathing)
- R-50 Roof Insulation
  (existing 2x7 framing filled with cellulose insulation and (2) 2" layers foil-faced polyisocyanurate insulating sheathing on roof sheathing)
- Windows
  (Low-E triple pane krypton filled, U = 0.20 & SHGC = 0.44)



Enlarged Details

4" Polyisocyanurate Foam



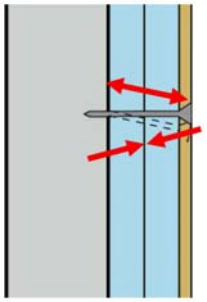
Foam Sheathing Cladding Attachment

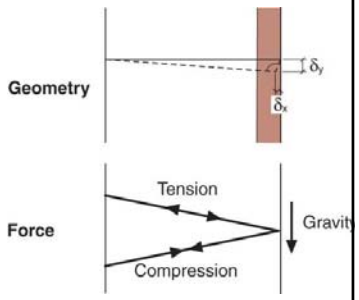
250 lbs/113 kg load (7.8 psf): <0.003" deflection

Wood siding ~2 psf
Fiber cement 2-3 psf
Stucco 8-10 psf

Image c/o Petersen Engineering

Foam Sheathing Cladding Attachment





Rotational resistance provided by tension in fastener and compression of the insulation

See: Exterior Cladding Attachment Research, Peter Baker, EEBA 2012: http://www.buildingscienceconsulting.com/presentations/documents/2012-09-26%20EEBA%20Baker%20Cladding%20Attachment.pdf

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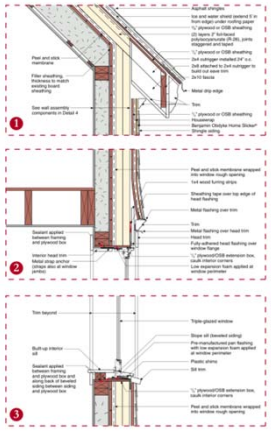

Enlarged Details

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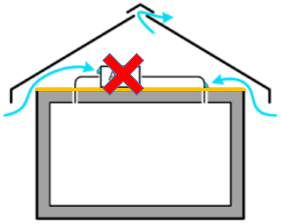
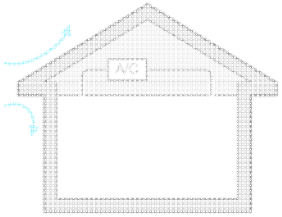
Vented and Unvented Roofs



(Conventional) Ventilated Attic



Unvented Cathedralized Attic

- Vented roofs good solution for low cost, durable, high-R assembly, IF:
  - No mechanicals in vented roof AND
  - Good air barrier at attic floor

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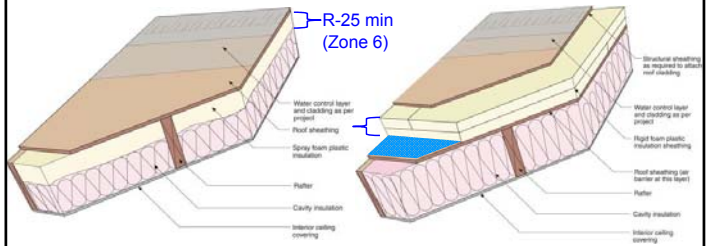
Unvented Roof: How?



- 2006 IRC: R806.4 Unvented attic assemblies
- Minimum R-value of "air impermeable insulation"
- Nail base needed with rigid foam on roof deck
- Air barrier on interior side of "roof sandwich"

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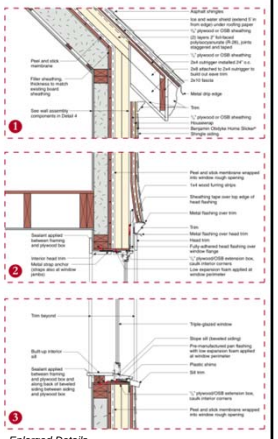

Enlarged Details

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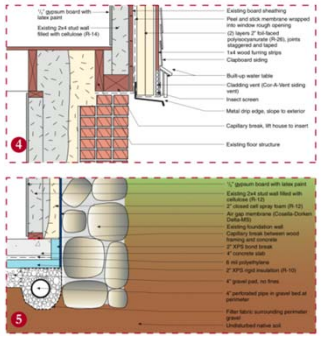
Water Control: Pan Flashings

•Deep energy retrofits (addition of insulation at existing wall) can make the wall more vulnerable to water leakage

•Previously "survivable" leaks may no longer be able to dry out.

Enclosure Design (2 of 2)

- R-24 Basement Walls
  (2" closed cell spray foam with 2x4 stud wall filled with cellulose)
- R-13 Rim Joist Area
  (2" closed cell spray foam with 2x4 stud wall filled with cellulose)
- R-10 Basement Slab
  (2" XPS below slab)



Enlarged Details

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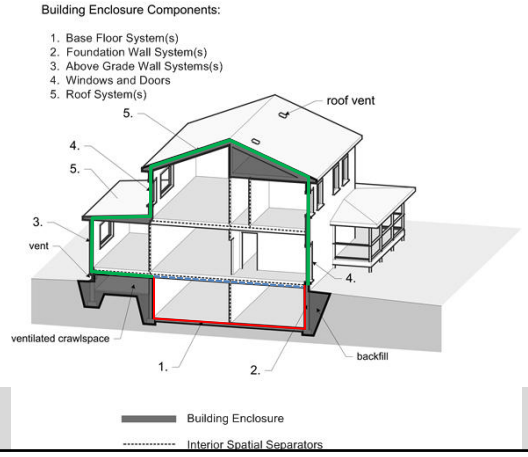
Basement Insulation Location



Basement Insulation Location

- 4.6 ACH50; 2129 CFM 50 total; 1100 CFM 50 through floor
- 8.5 ACH50; 3590 CFM 50 total; 1740 CFM 50 through floor

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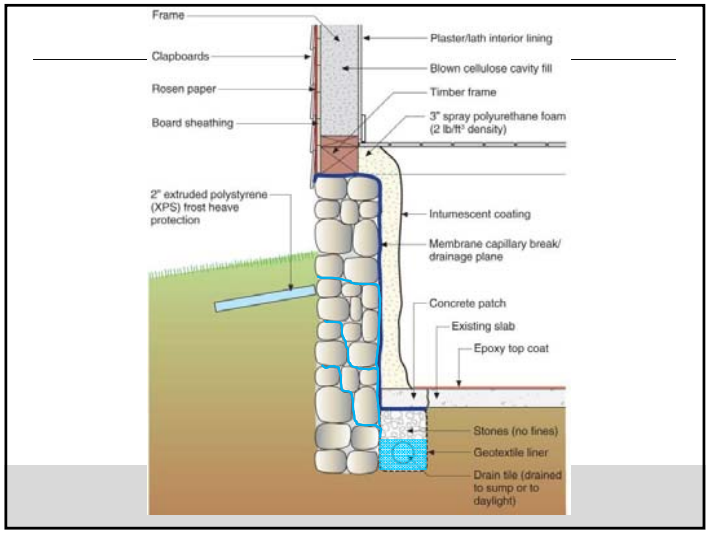
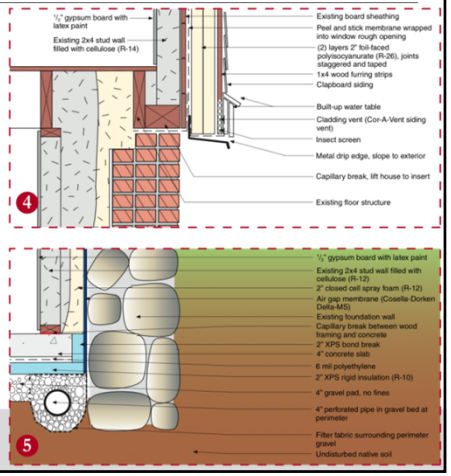


Foundation Insulation Details

- Stud wall and cellulose insulation for additional R-value
- 2" XPS sub-slab insulation



Air Barriers

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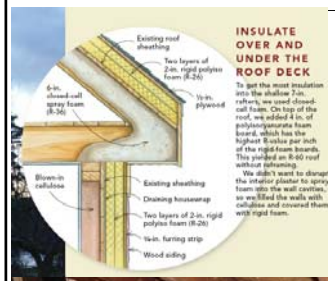
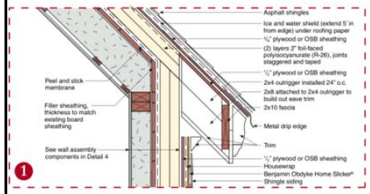
Roof-to-Wall Air Barrier Connection



"Chainsaw" Retrofits (Roof-to-Wall)



See "The History of the Chainsaw Retrofit" (Green Building Advisor)
http://www.greenbuildingadvisor.com/blogs/dept/musings/history-chainsaw-retrofit

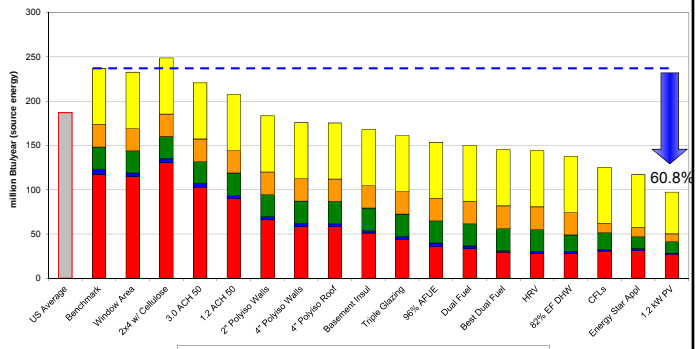
Wall Retrofit Air Barrier Options

Self-adhered Membrane as Air Barrier

- 69 CFM 50 (0.09 ACH 50) w. blanked off openings
- 337 CFM 50 (0.4 ACH 50) pre-drywall

Energy Performance

Parametric Simulation Loads

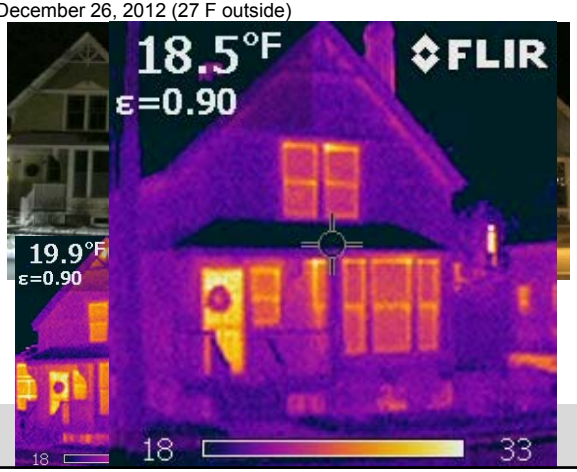


Graph shown as source energy (million Btu/year)

Infrared Images

Infrared Images

- December 26, 2012 (27 F outside)



Infrared Images

Snow Melt Patterns

- One of these things is not like the other…

Questions?

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