Breathing New Life into Aging Homes

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Context

- Huge building stock
  - About 13 million households in Canada
  - Housing Starts 200 000/yr
  - Replacement time 65 yrs with no growth rate
- Many older homes in good locations
- Retrofit and Renovation usually driven by
  - Comfort, healthy, durability, amenity
  - Not energy

Choices

- Changing mechanical systems is least invasive
  - often near end of life (20 yrs)
  - 10% eff improvement = 10% operating savings = easy
- Lighting and ventilation
  - Many buildings have too many inefficient lights that are on for too long
  - Most buildings have too much ventilation with too little control
  - Can be major savings (30-50%)
- MUST have clear idea of enclosure upgrades before deciding on mechanical!

Enclosure Retrofit

- Important target for many buildings
  - Airtightness
  - Windows
  - Insulation
    - Roof
    - Walls
    - Basement
    - Slabs
- Prioritize by Ease and Impact

Walls

- Major aesthetic element
  - Curb appeal and satisfaction
- Expensive to change
  - Cant usually pay just for upgrade
- Usually need a reason to retrofit
  - Cladding past service life
  - Comfort / durability problems
  - Major interior renovations

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Targets

- R20-40+ True R-value
  - Climate and energy sources matter
- Airtightness
  - ACH@50 <3?? 2??
  - Depends on energy target
- R40 wall with 5 ACH50 makes little sense
- R20 wall with 1 ACH50 makes little sense

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Wood-framed Walls

- Can add insulation if voids empty
  - Experience with weatherization
  - Should do everytime as a start
- Airtightness & Insulation level improvements are limited
  - Hard to get to “modern” levels
    - R20+ and < 2 ACH@50
  - May be as far as some can afford
- Cant improve RAIN control

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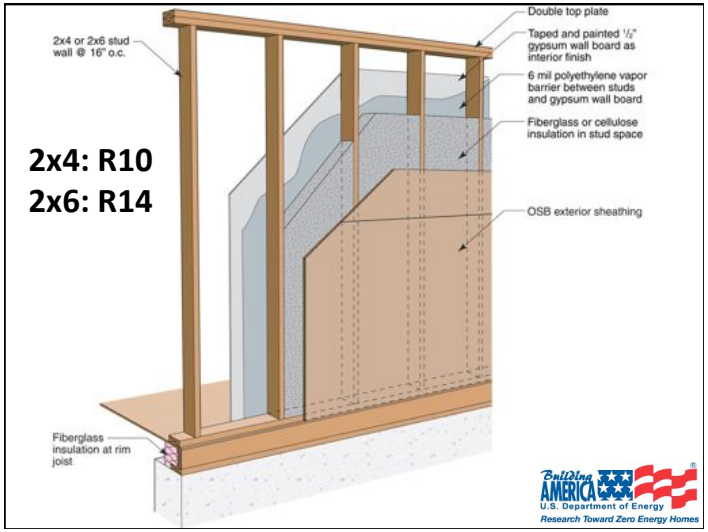

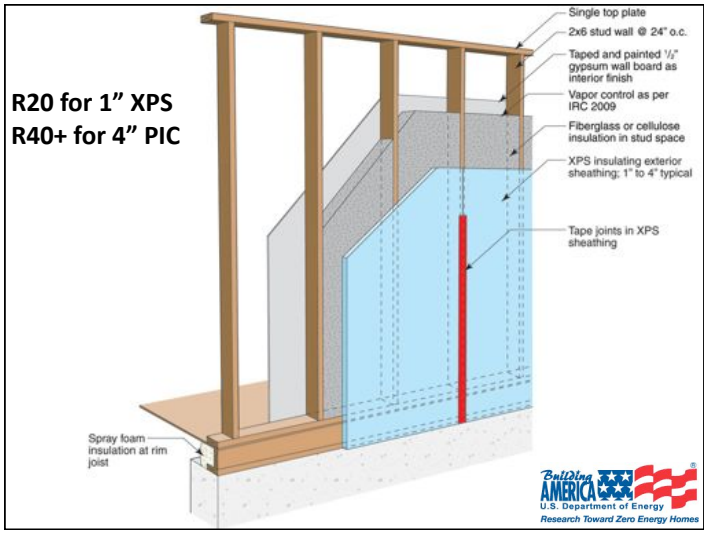

Exterior Insulation Retrofit

- Any reasonable level of insulation can be provided
  - Final R of 20, 30, 40, 50
- Almost all penetrations of air, heat, and rain can be improved
- New drainage plane
- Critical to deal with windows
- Significant reductions in moisture risk

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Exterior Insulation Retrofit

- Challenges
  - How to attach cladding
  - How to detail windows
  - Porches
  - Overhangs
  - Foundation transition

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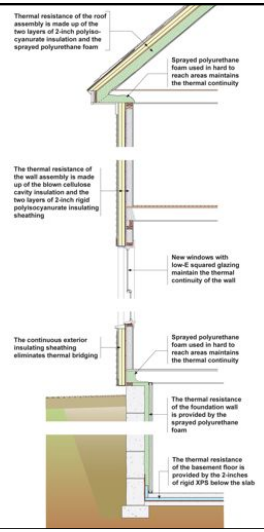
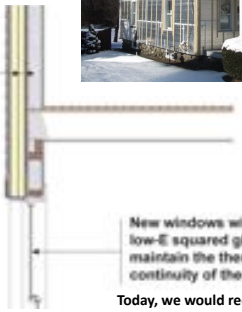
Thermal Continuity

•Continuous
•High R-values
•Warm& protect wood structure



Thermal Continuity

The thermal resistance of the wall assembly is made up of the blown cellulose cavity insulation and the two layers of 2-inch rigid polyisocyanurate insulating sheathing

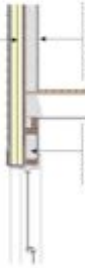


New windows with low-E squared glazing maintain the thermal continuity of the wall

Today, we would recommend triple-glazed with compression seals for airtightness

Condensation Control

Polyisocyanurate elevates the surface temperature of the exterior sheathing during the winter to reduce the condensation potential



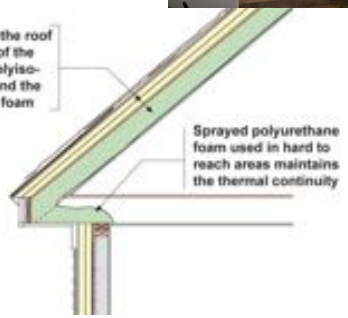
Semi-permeable interior latex paint finish on gypsum board reduces moisture flow from interior during winter yet still allows drying to the interior during summer

Cellulose insulation acts as a hygric buffer by safely storing moisture until it can dry to either the interior or exterior

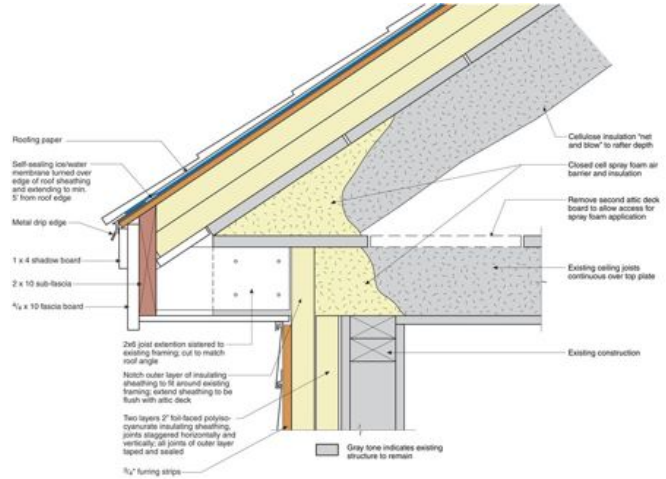
Roof to wall

Thermal resistance of the roof assembly is made up of the two layers of 2-inch polyiso-cyanurate insulation and the sprayed polyurethane foam

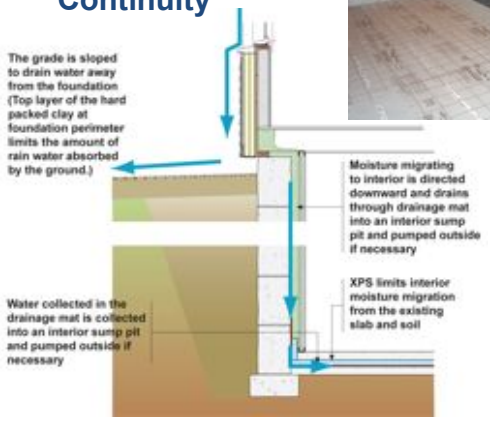
Normally we would use blown cellulose or fiberglass in rafter space, foam for airsealing



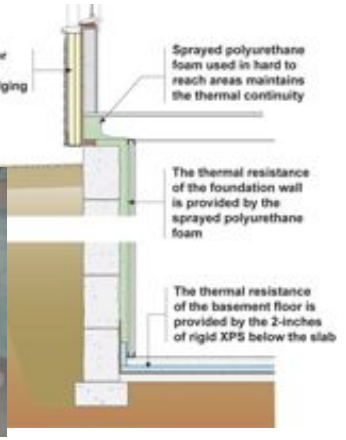
Sprayed polyurethane foam used in hard to reach areas maintains the thermal continuity



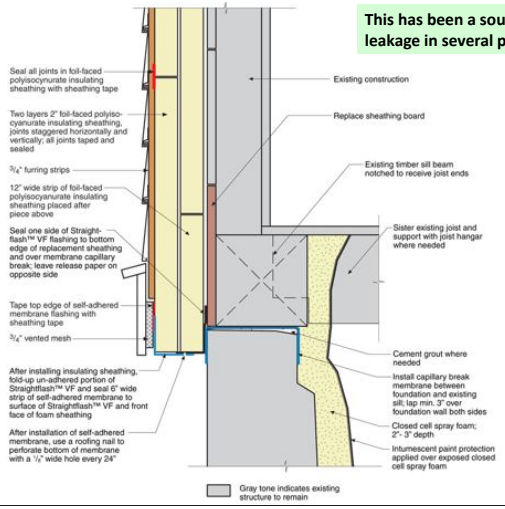
Drainage Plane Continuity



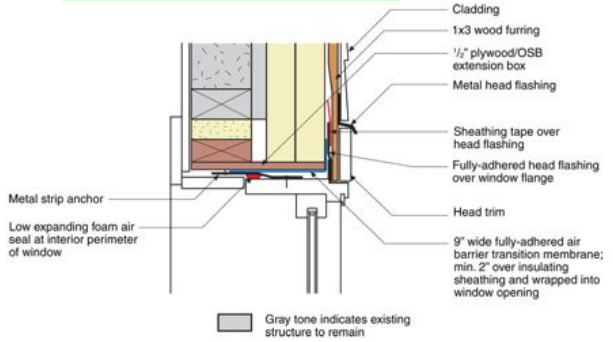
Thermal Continuity

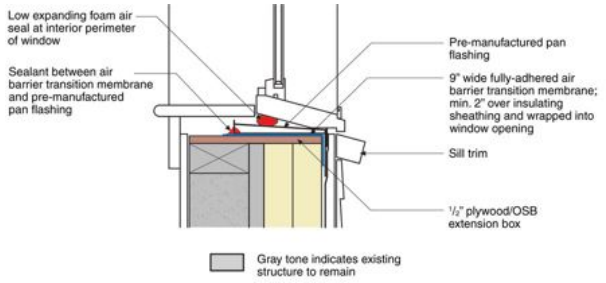


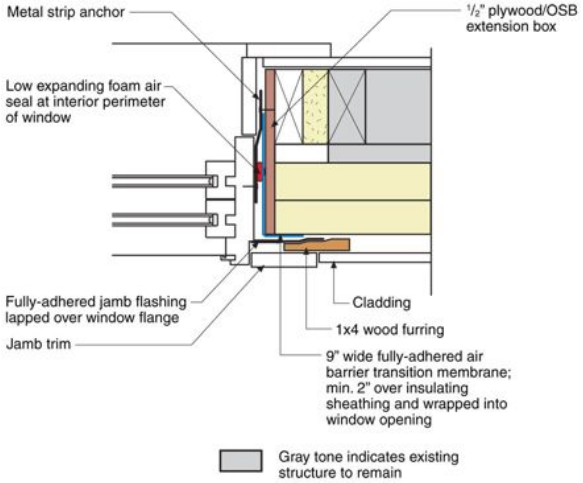
This has been a source of air leakage in several projects



Windows: add a window buck is best
Control rain leakage, use subsill flashing







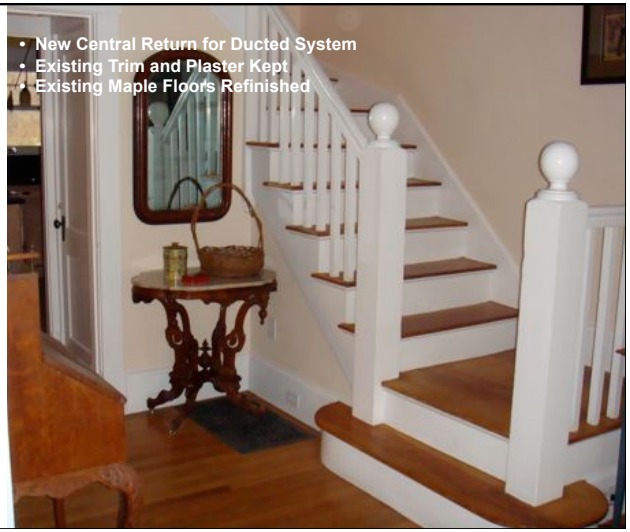
New Windows

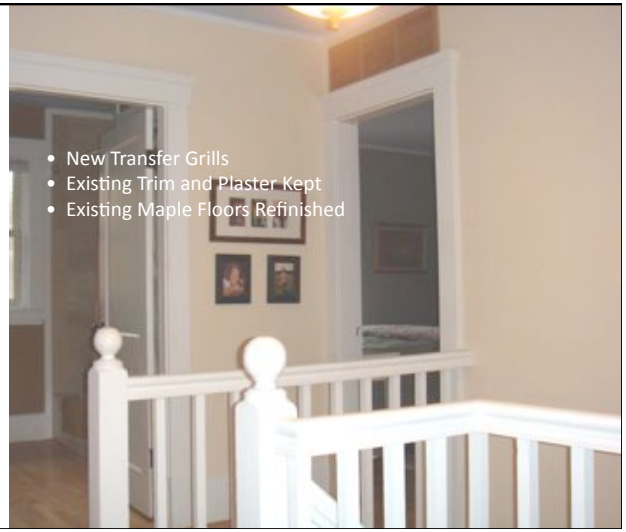
Photos courtesy of Dan Morrison, *Fine Homebuilding Magazine*

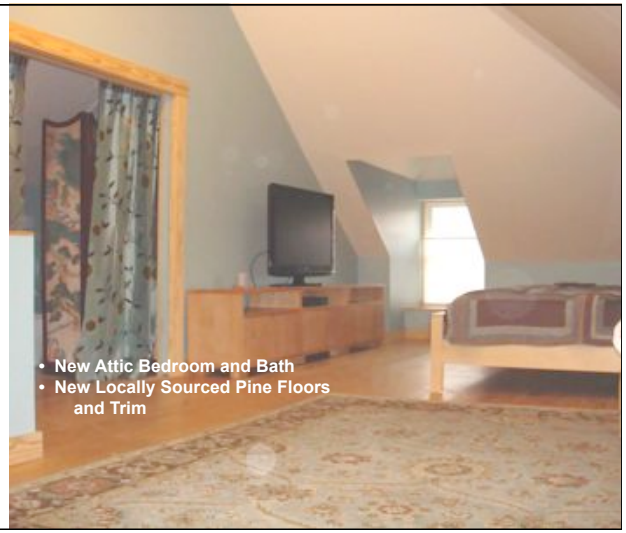
New Windows


• Existing Fireplace Kept
• Existing Trim and Plaster Kept
• Existing Maple Floors Refinished
• No VOC Paint used Inside and Out


• All Plywood Boxes for Cabinets
• Existing Maple Floor Found and
• Gas Range Vented to Outside
• Energy Star Appliances
• All Pin Based CFL Package


• New Central Return for Ducted System
• Existing Trim and Plaster Kept
• Existing Maple Floors Refinished


• New Transfer Grills
• Existing Trim and Plaster Kept
• Existing Maple Floors Refinished


• New Attic Bedroom and Bath
• New Locally Sourced Pine Floors and Trim


5 kWp of PV offsets more than annual electric consumption
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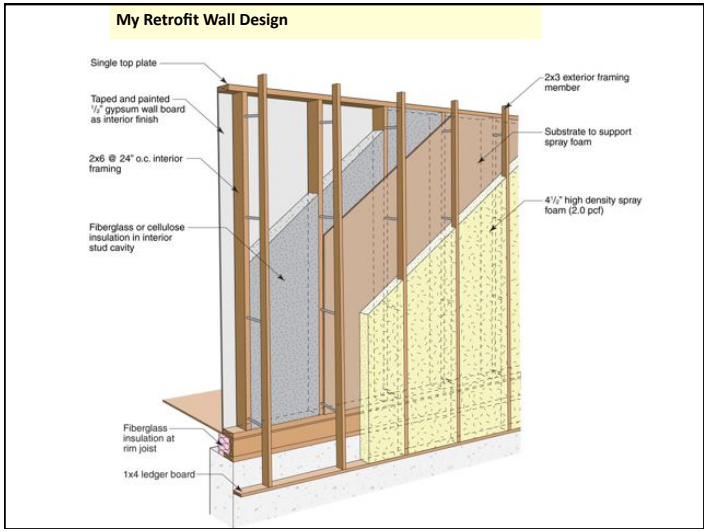
My retrofit


My Retrofit Wall Design
Single top plate
Taped and painted ½" gypsum wall board as interior finish
2x6 @ 24" o.c. interior framing
Fiberglass or cellulose insulation in interior stud cavity
Fiberglass insulation at rim joist
1x4 ledger board
2x3 exterior framing member
Substrate to support spray foam
4½" high density spray foam (2.0 pcf)


HOME