NESEA™
NORTHEAST SUSTAINABLE ENERGY ASSOCIATION

BuildingEnergy 2014

High Performance Enclosures

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BuildingGreen
March, 2014

BuildingGreen.com

High Performance Enclosures

- Water Barrier
- Air Barrier
- Thermal Barrier
- Vapor Profile (not just the designated vapor retarder)
- Finishes (UV protection)
- Commissioning & Maintenance documents

Water Barrier(s)

- Drainage plane – moving bulk water down, out, off
  - Exterior claddings
  - Concealed weather-resistive barrier (WRB)
  - Flashings
  - What connects to what?
- Capillary breaks – managing water held in tension in and between porous building materials

Air Barrier

- Materials –
  Air Barrier Association of America (ABAA) and ASTM E 2178 - Air permeance of .02 $l/m^2 \cdot s$ @ 75 Pa or less
  - Tyvek - yes
  - Typar - yes
  - Drywall: yes
  - Concrete block: no
  - 1-inch Type II EPS insulation: yes
  - Sprayed-in-place cellulose - no
  - ½-inch asphalt impregnated fiberboard - no
- Assemblies - .2 $l/m^2 \cdot s$ @ 75 Pa or less
- Enclosures - 2 $l/m^2 \cdot s$ @ 75 Pa or less

Thermal Barrier

- Insulation and glazing performance in terms of all three vehicles for heat transfer
- R (resistance to heat conduction) – 1/U (heat conductance)
- Material, field of wall, whole assembly performance

Vapor Profile: Assemblies Designed to Dry – Four Steps

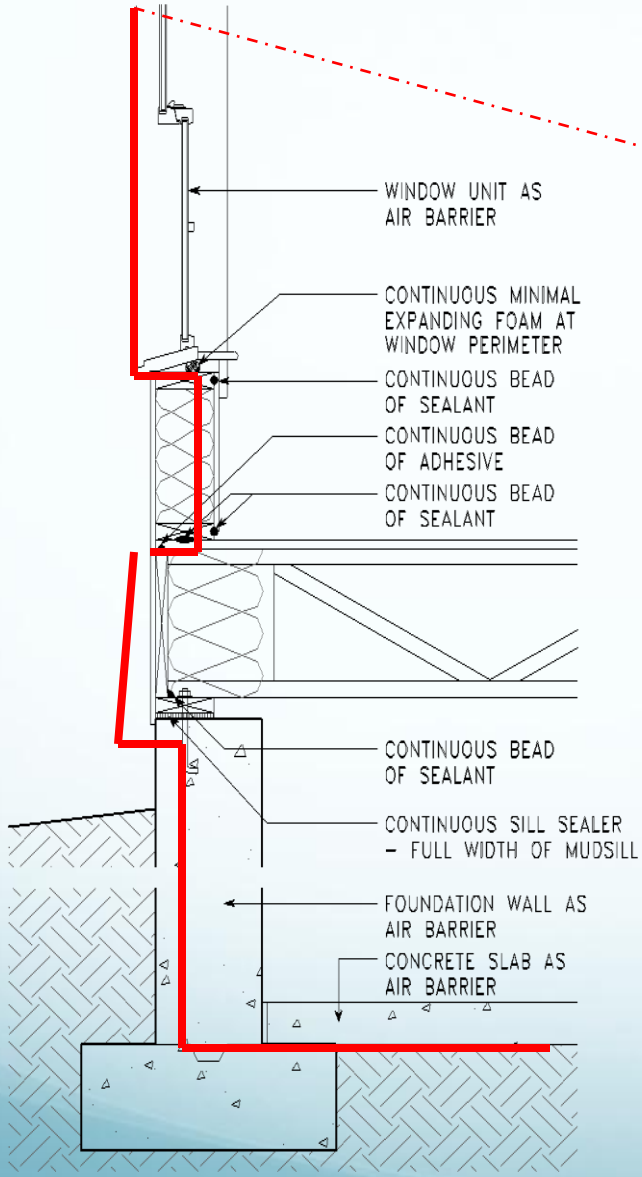
1. Determine vapor permeability of each component of assembly
2. Identify least vapor permeable component(s)
3. Assess direction and extent of vapor drive: interior/exterior temperature difference, interior/exterior relative humidities (remember always high to low)
4. Identify/assess drying direction & potential

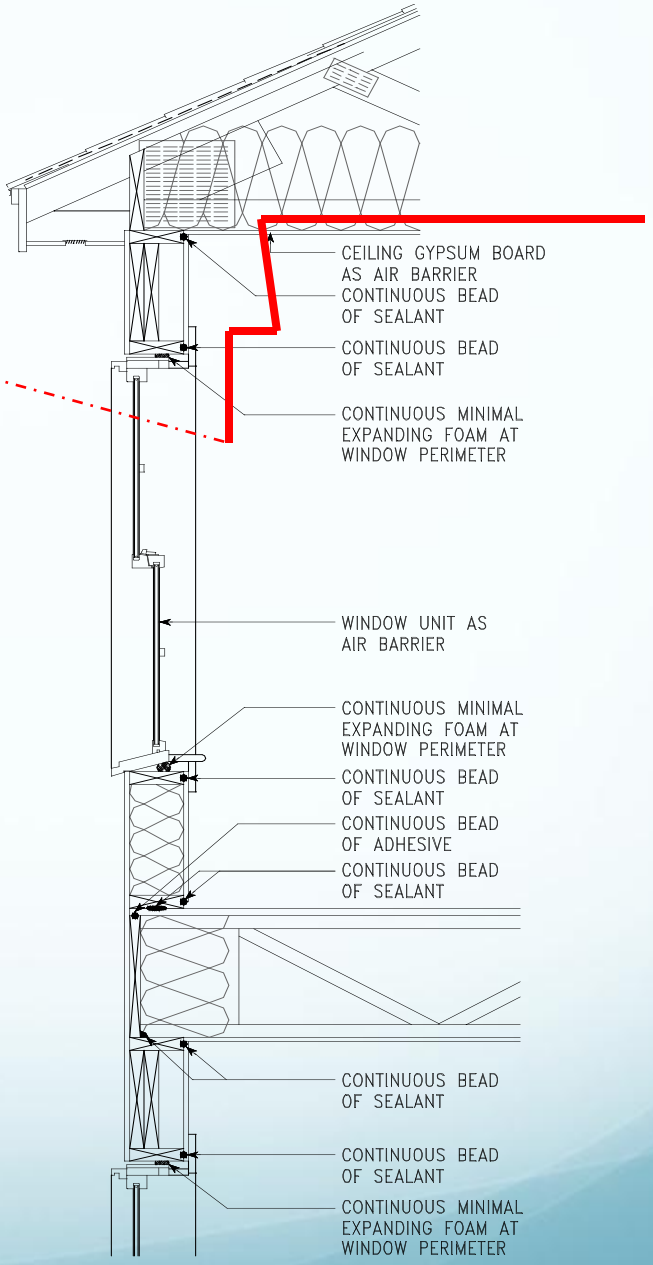
"Vapor Profiles Help Predict Whether a Wall Can Dry"

Qualities of the major protection systems

- Systematic
- Comprehensive
- Continuous
- Best Practices
- Each system should be addressed by at least one, preferably two, ideally three of the following:
  - Design; Materials; Workmanship

The Principle of Continuity





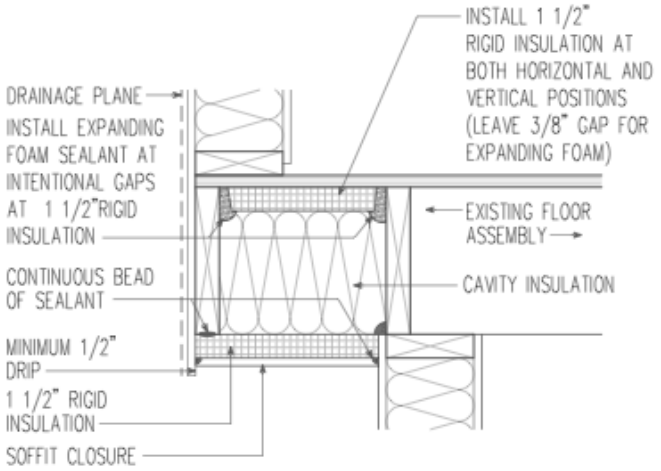
Areas of Focus for the BE Protection Systems

- Below-grade walls, Above-Grade walls, Roofs
- Underlayments
- Claddings
- Penetrations
- Margins
- Transitions

The Process

- Design Details
- Specifications
- Performance-based Scopes of Work

Design Detail



INSULATED CANTILEVER FLOOR // CAVITY INSULATION WITH 1 1/2" RIGID INSULATION CLOSURE

GreenBuildingAdvisor.com

Scale: 1 1/2" = 1'-0"

5-01020

Specification

SECTION 07210

BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Provide building insulation, air sealing and vapor retarders.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Submit for approval test reports.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

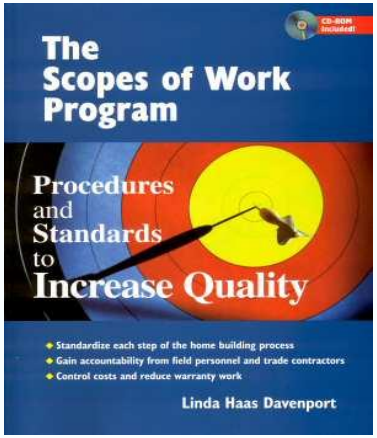
B. Insulation contractor must complete the ½ -day field training/review with a technical representative of the Environments for Living® program

C. Blower door test every structure as a measure of the air tightness. Air leakage is not to exceed 0.25 cfm per square foot of enclosure surface area, as tested at 50 Pa (pascals) pressure differential.

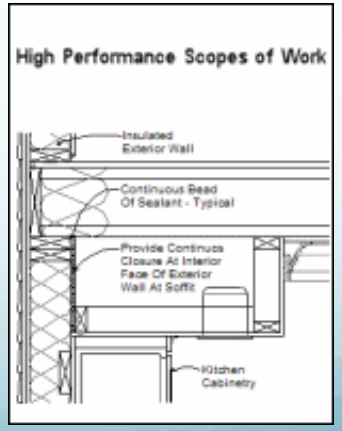
D. Conduct random Infra-red camera inspections of the building enclosure, at the discretion of New Town Builders.

Scopes of Work

- Davenport approach:
  - Pre- and post-checklists
  - “All or nothing”
- Building America approach:
  - Critical details integration
  - Performance tests



High Performance Scopes of Work



High Performance Scopes of Work

- Foundation
- Framing
- Drainage Plane
- Windows
- Air Sealing/Insulation
- HVAC

Issues

- Alternative shear: let-in bracing, inset shear panels, SIS
- Sills: sloped vs. backdam
- WRB: building paper, housewrap, taped sheathing, liquid-applied
- Vented air space: spacer mesh vs. furring strips

Alternative Shear

Metal T-straps

- Simple
- Relatively inexpensive
- Limited capacity

BSC

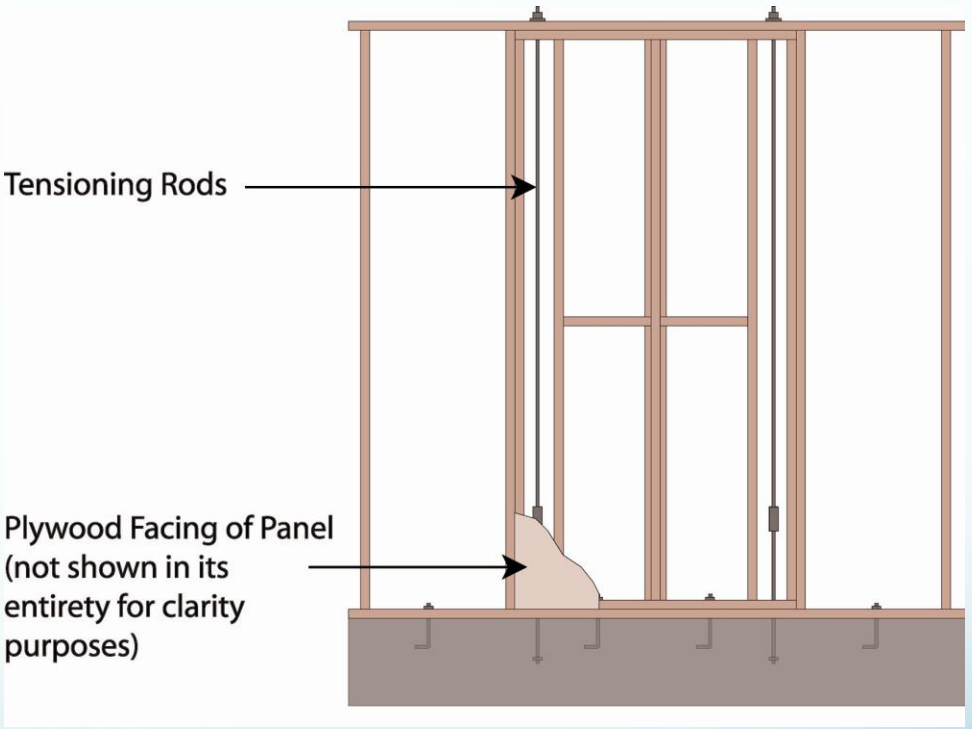
Alternative Shear

Pre-manufactured shear panels

- Higher capacity
- Higher cost

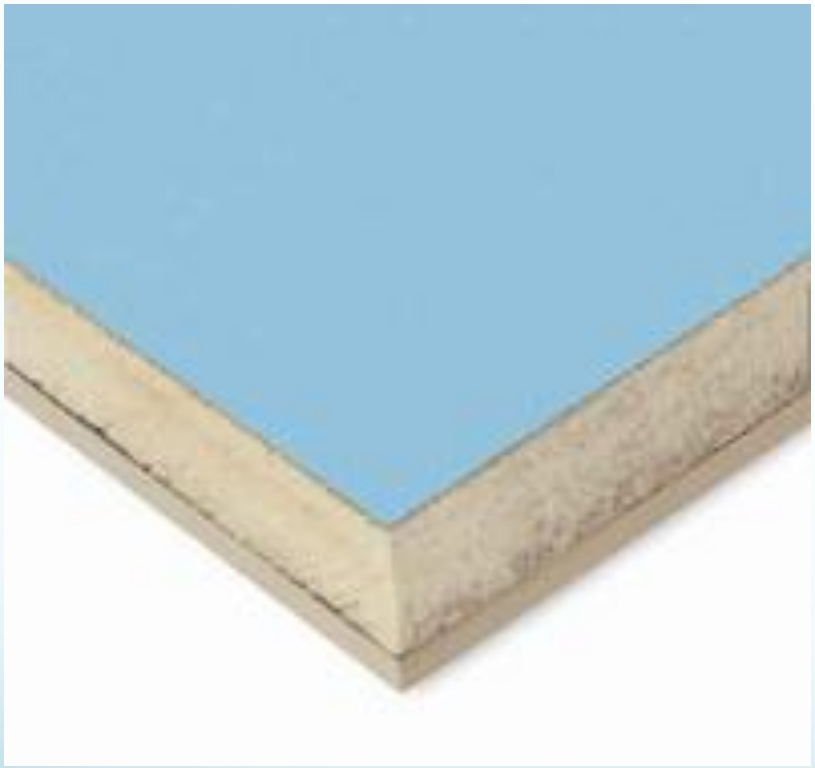
BSC

Alternative Shear

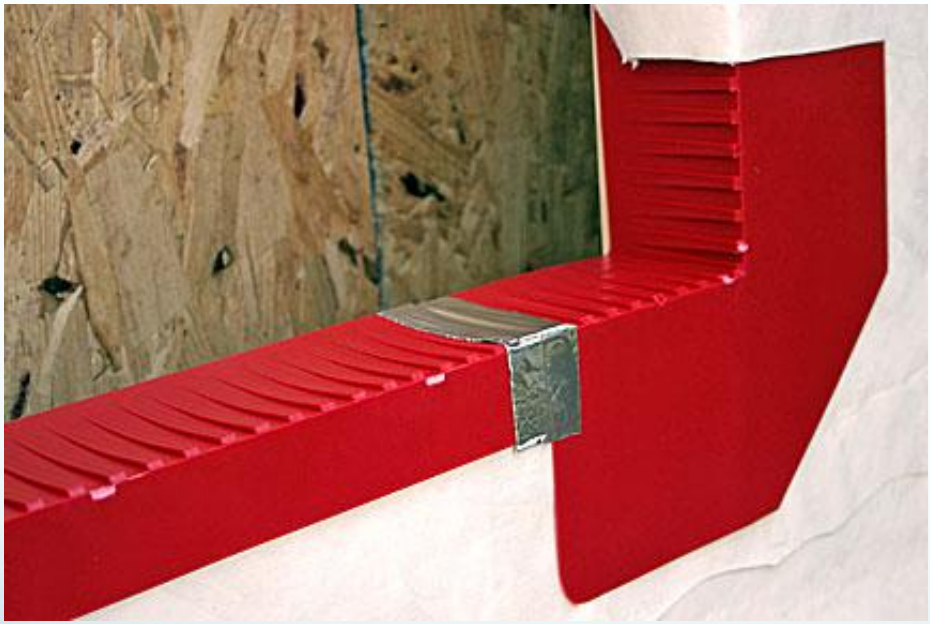


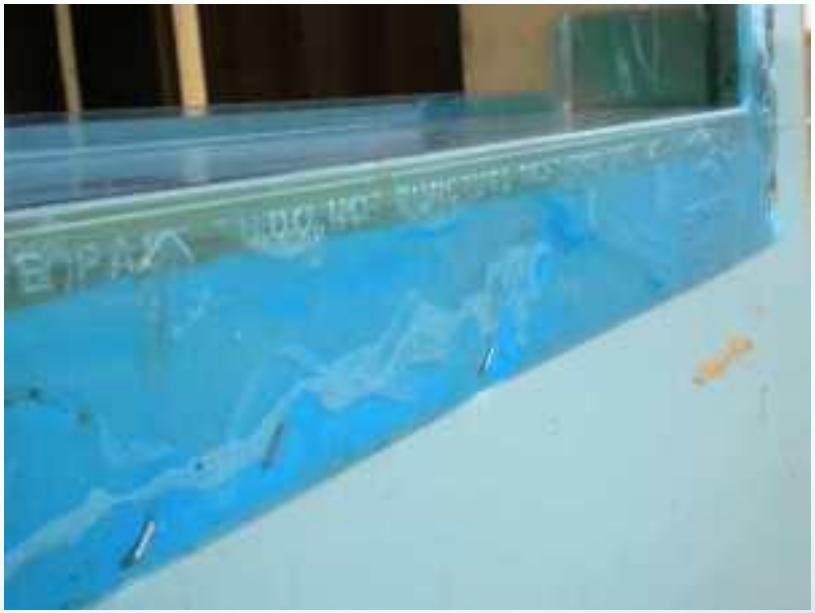
BSC

Alternative Shear - SIS



Sills





Weather-Resistive Barriers

- ASTM D779-94: the “boat” test: “It is designed for use with materials that require a relatively short time to test (up to approximately 30 s)…”
- AATCC 127, the "hydro-head" test: 22-inch column of water leakproof for 5 hours (approximating a 200 mph wind-driven rain)
- The code? “equivalent” materials—24 different test standards may apply
- Don’t use perforated or gross crosswoven


Furring Strips
Tyvek
HomeWrap


POLYISOCYANURATE INSULATION

Adding exterior insulation

- Shear across the rigid insulation
- WRB location
- Window location
- Connecting the two

BSC shear research

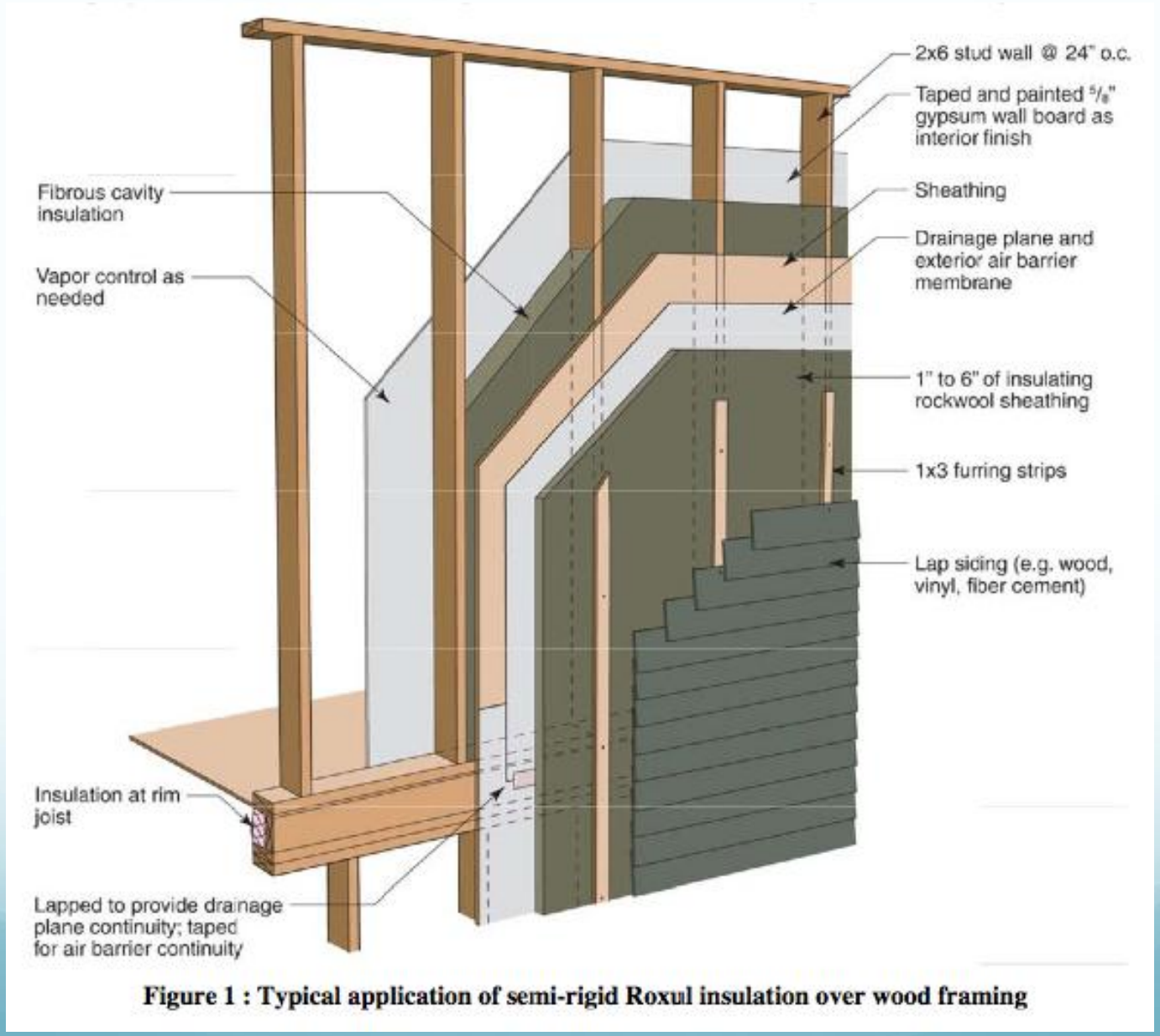


Figure 1 : Typical application of semi-rigid Roxul insulation over wood framing

OSB deflection testing Roxul

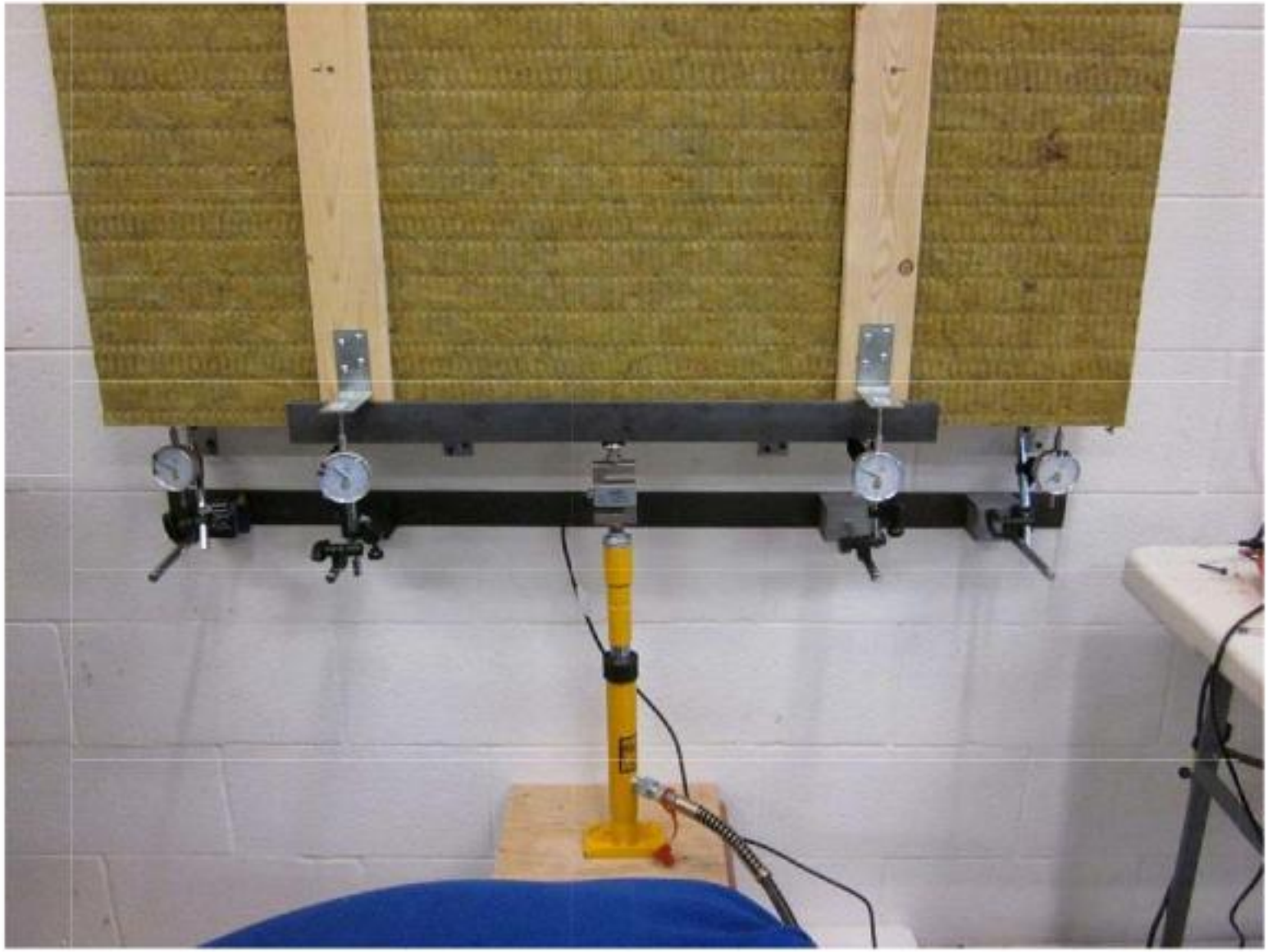


Figure 4: Hydraulic Ram with load cell and deflection gauges measuring strapping movement

X-insulation over water and air barriers

Pressure-

Equalized

Rain

Screen

Insulating

Sheathing

Technique

Pressure
Equalized
Rain
Screen
Insulating
Sheathing
Technique

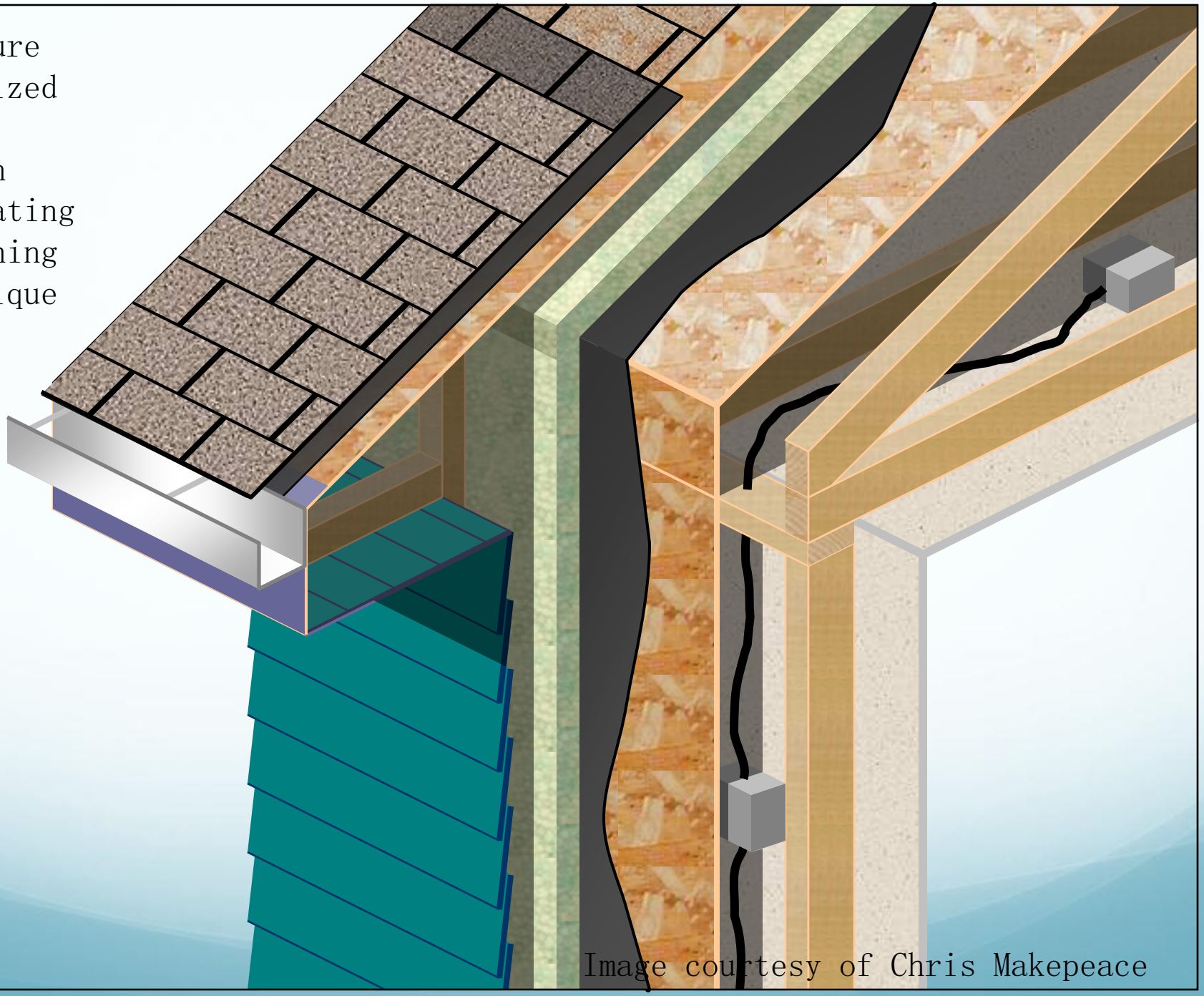


Image courtesy of Chris Makepeace

The PERSIST Rules

1. Enclose the building in a continuous air barrier.
2. Provide continuous support for the air (*seal*) barrier against wind loads.
3. Ensure that the air (*seal*) barrier is flexible at joints where movement may occur.
4. Provide continuous insulation to keep the air barrier warm and to conserve energy in the building.
5. Keep the insulation tight to the air barrier.
6. Protect the insulation with a rain screen/sun screen supported out from the structure in a way that does not penetrate the insulation with excessive heat bridges.
7. Provide enough open space for drainage and construction clearances between the rain screen and the insulation.
8. Drain the wall cavity to the outside."

Window trim channels "trapping" the SBS membrane

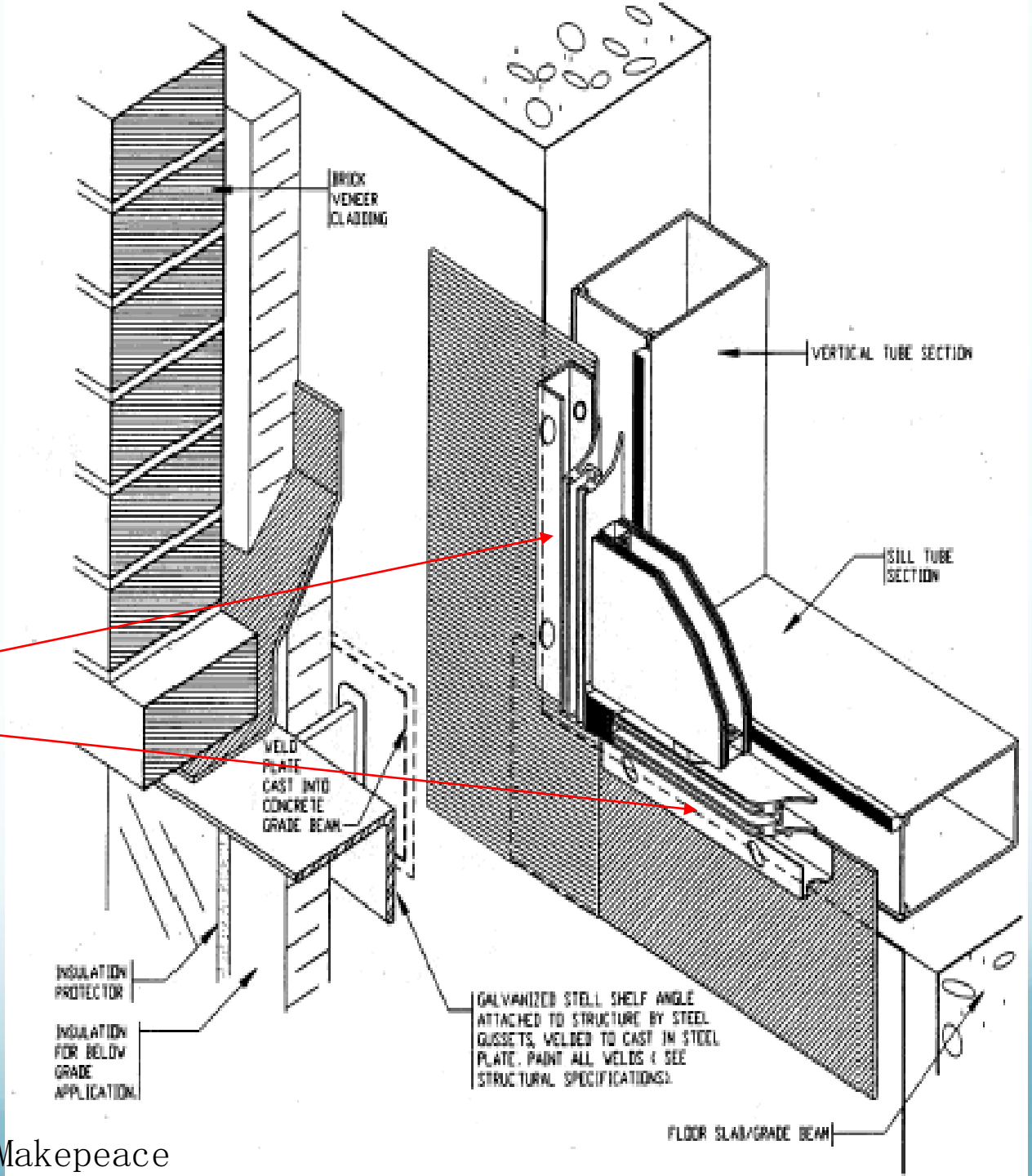
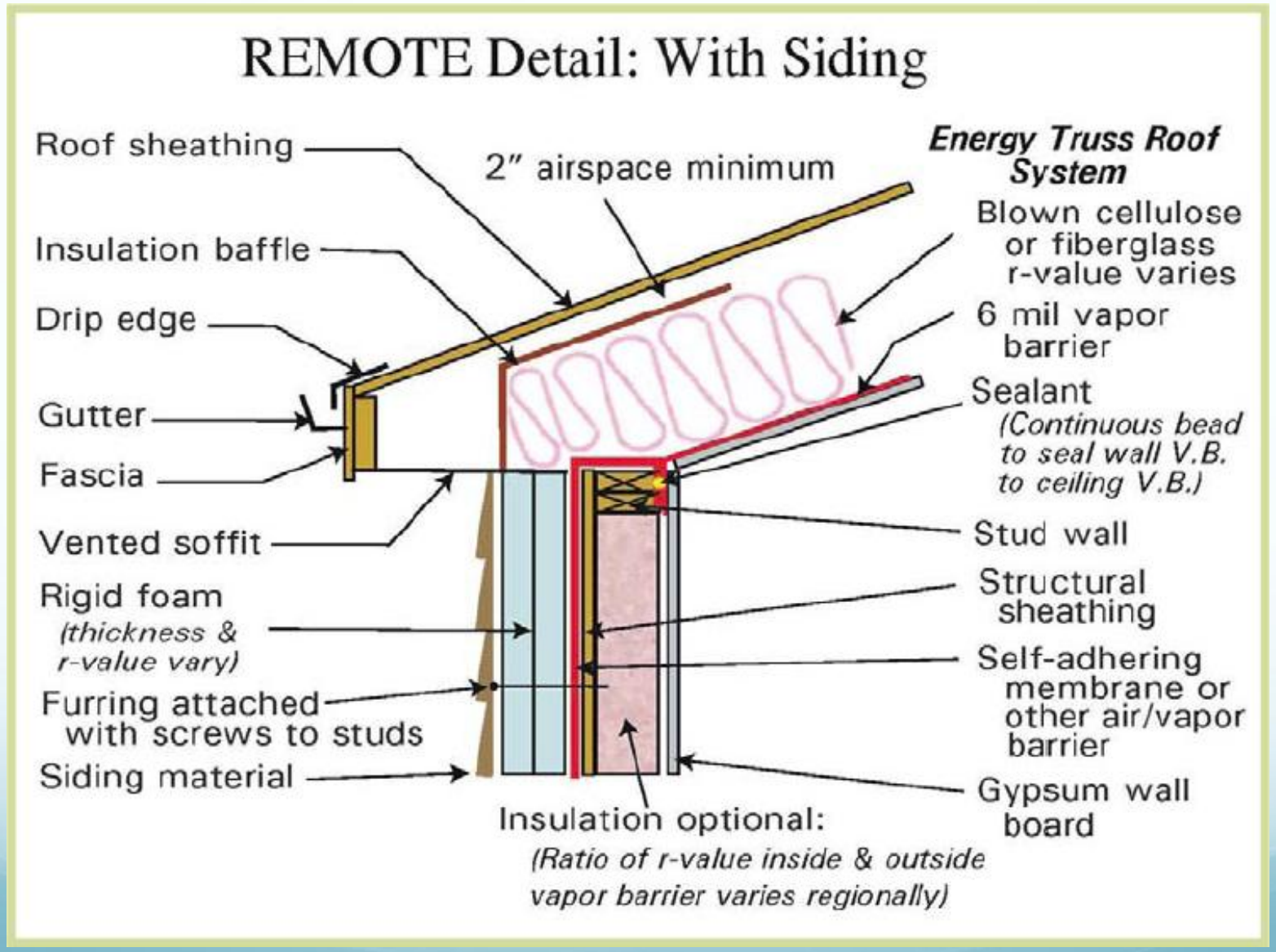


Image courtesy of Chris Makepeace

Residential Exterior Membrane Outside Insulation Technique



From CCHRC RS 2007-3

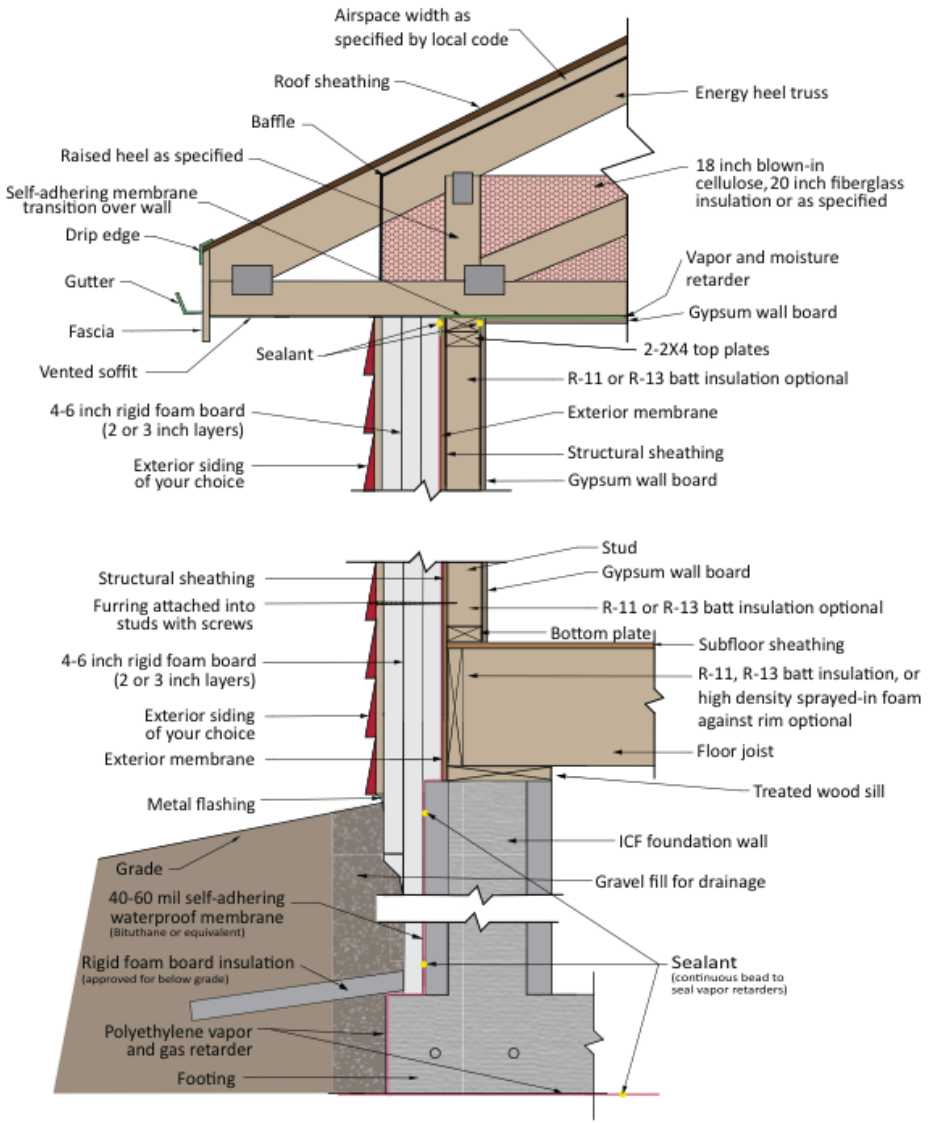


Figure 1. WALL CROSS SECTION

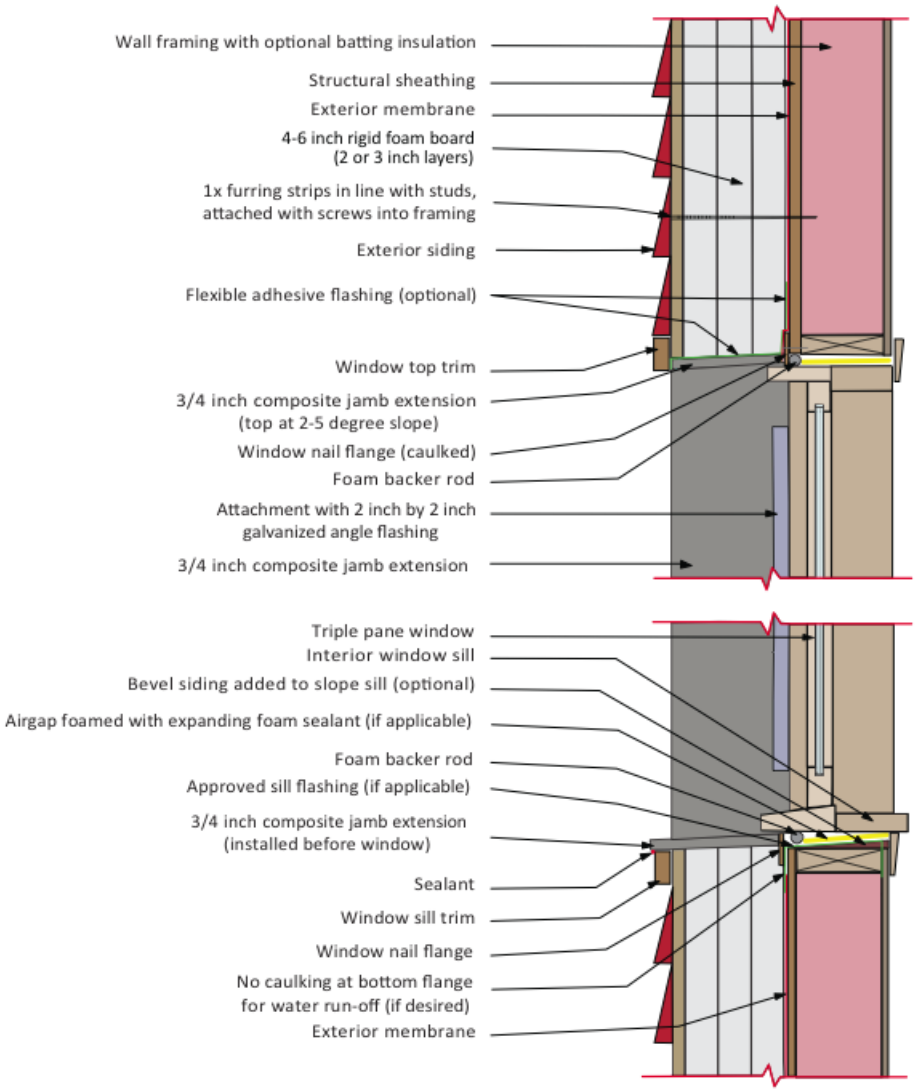


Figure 6. INSET WINDOW

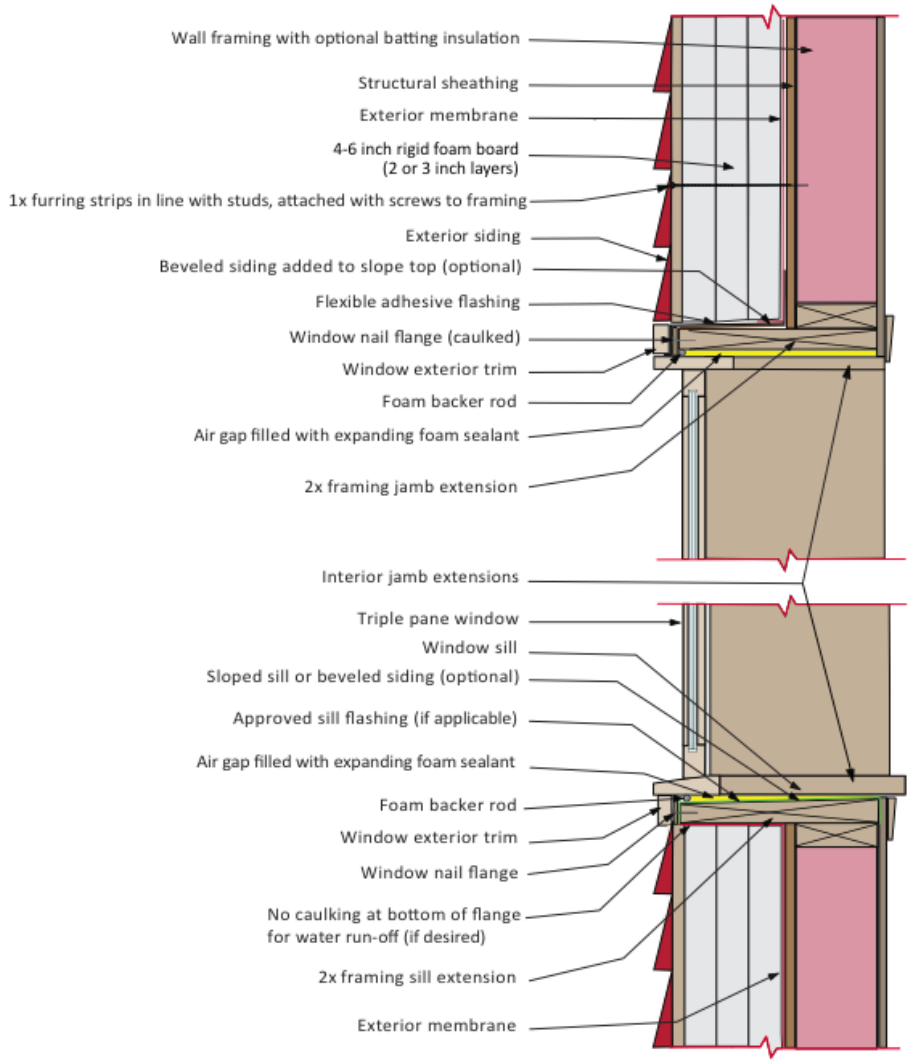
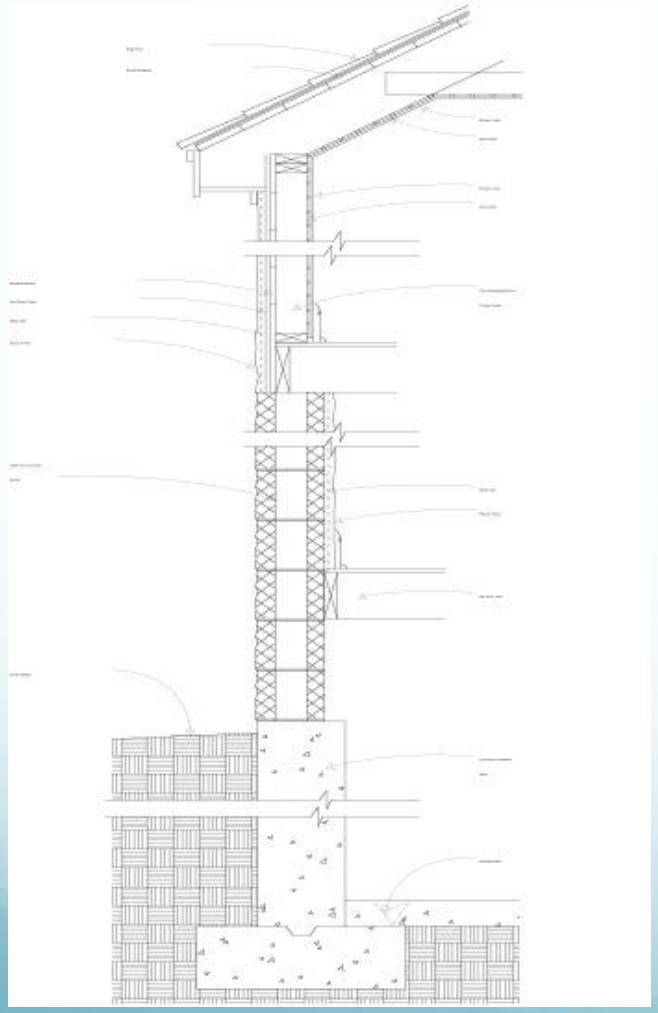
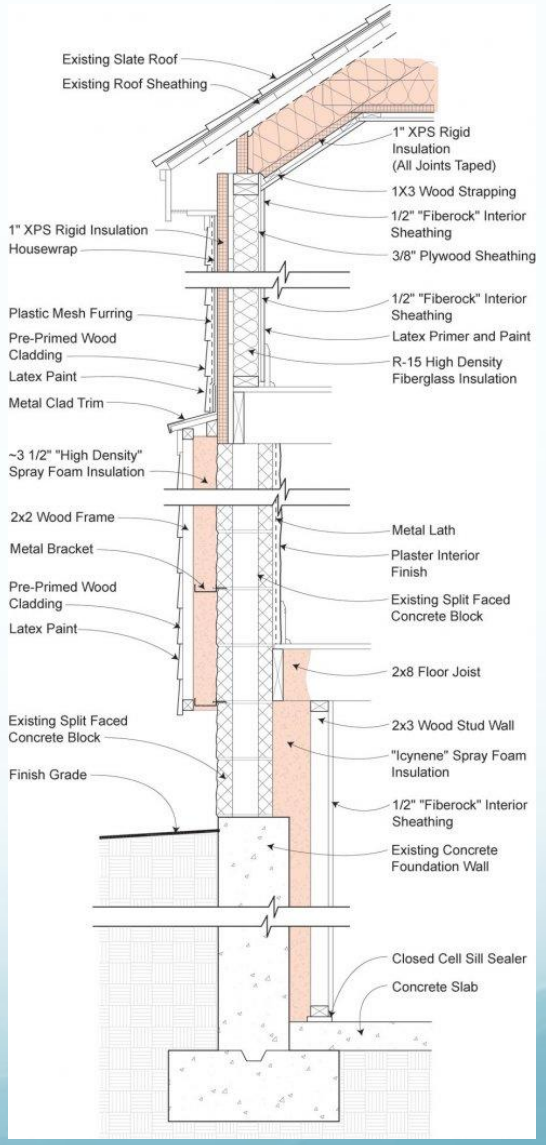


Figure 5. EXTERIOR-MOUNTED WINDOW

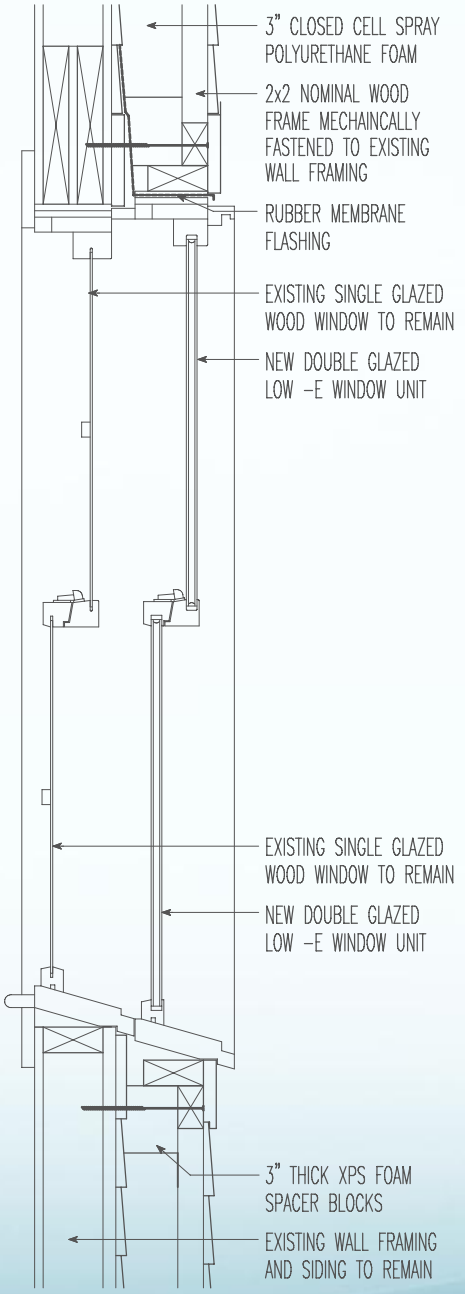
Deep Energy Retrofit
Windows & Walls

Brattleboro, VT





Somerville, MA

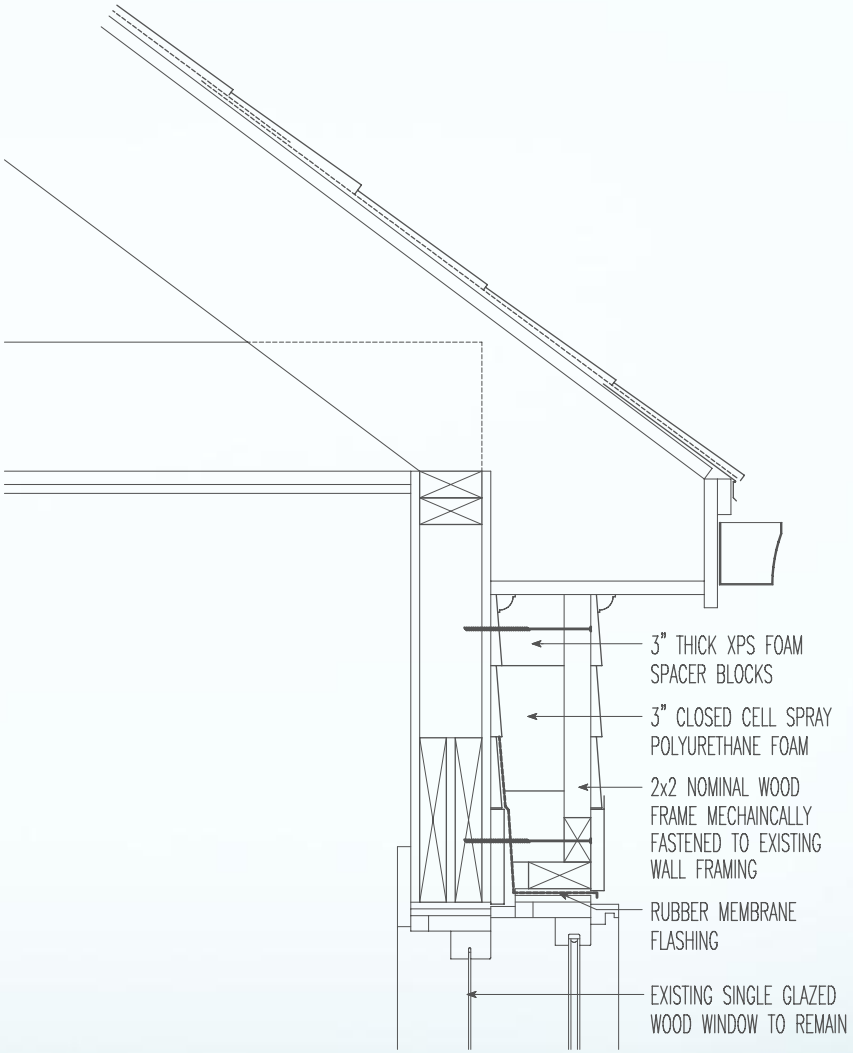


A-4 | NEW WINDOW PLACEMENT | SCALE 1 1/2" = 1'-0"

PRICEJONES RESIDENCE
30 SYCAMORE STREET SOMMERVILLE MA 02143

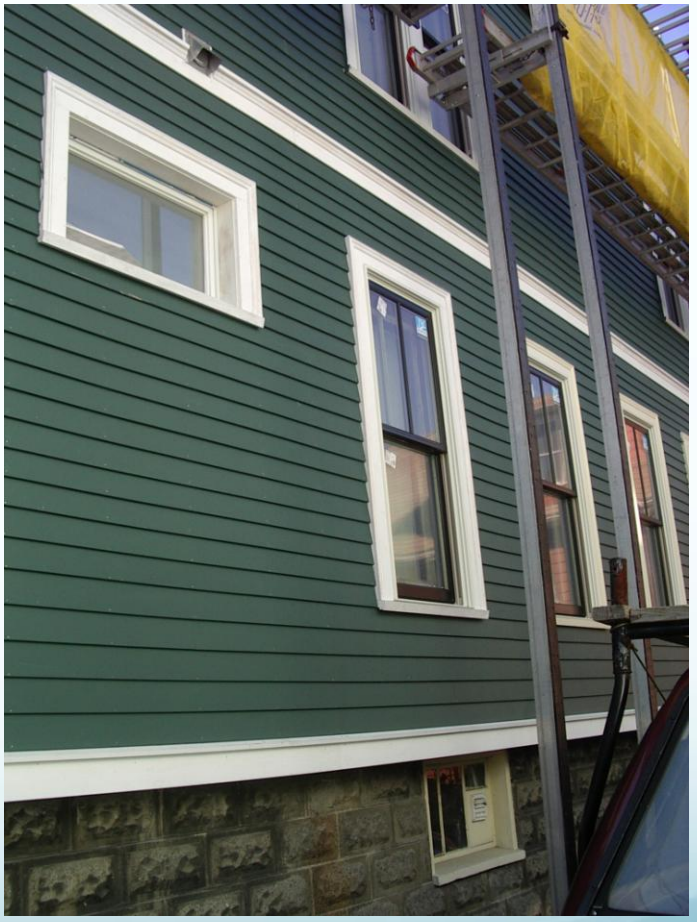
STEVEN BACZEK ARCHITECT
45 GLENMERE CIRCLE READING MA 01867 PH:781-942-9856

DATE: 9/1/08
REMARKS: submitted for review



A-5	NEW SIDING AT WINDOW HEAD SCALE 1 1/2" = 1'-0"	PRICEJONES RESIDENCE 30 SYCAMORE STREET SOMMERVILLE MA 02143	STEVEN BACZEK ARCHITECT 46 GLENMERE CIRCLE READING MA 01867 PH:781-942-9893	DATE: 9/1/08	REMARKS: submitted for review


Clementines from Spain



Video: Spray Foam Blankets a 100-Year-Old House

Video: Deep-Energy Retrofit, Portland, Oregon

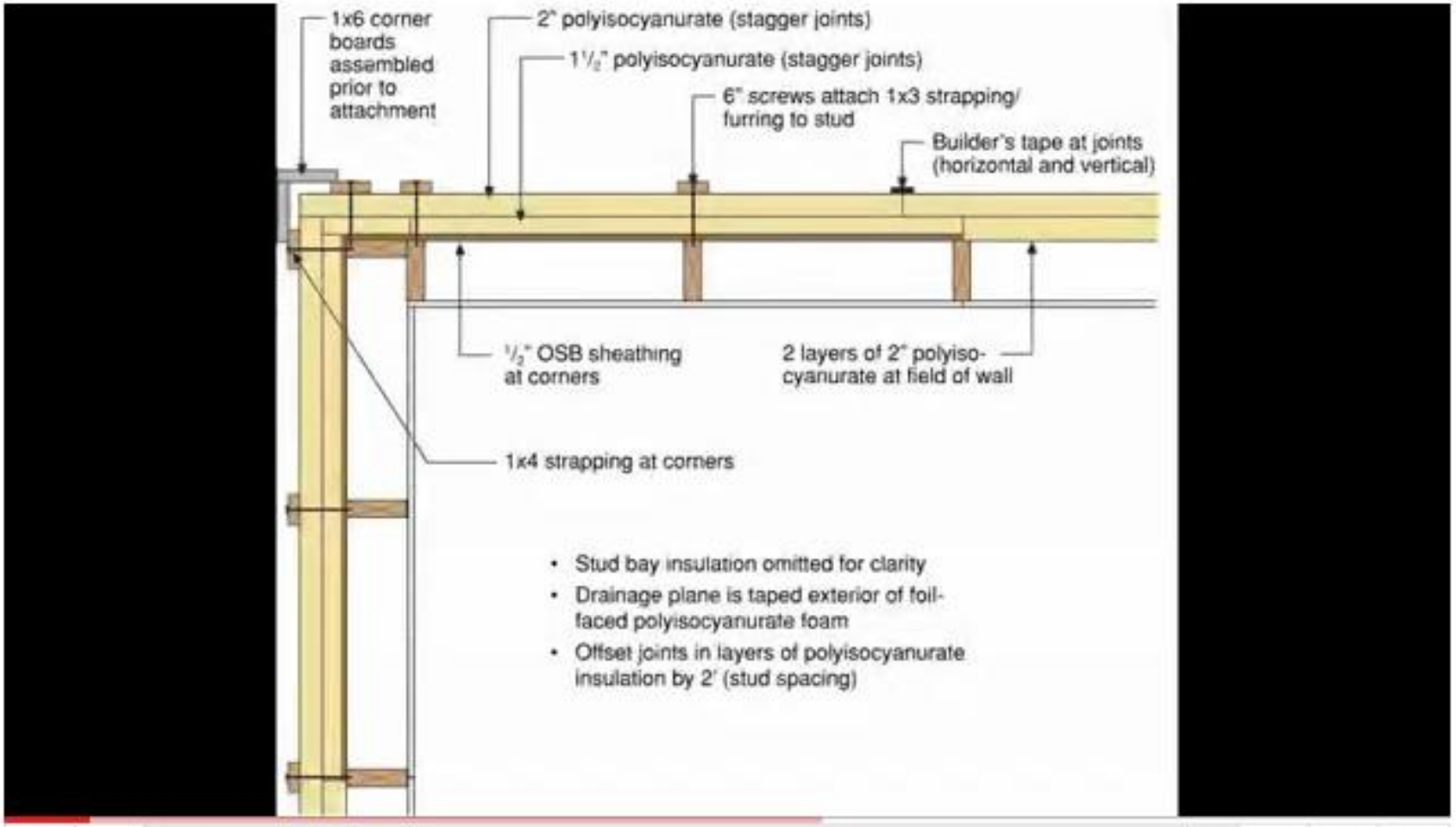
USE A GUT REHAB AS AN OPPORTUNITY TO RECONFIGURE EXTERIOR WATER MANAGEMENT AND REINFORCE YOUR FOUNDATION

Undo years of moisture damage and give new life to your foundation

YouTube Kohta Ueno, BSC window installation Search Bro

Installing a Window in an Exterior Insulated R40 Wall

BuildingGeek 14 videos Subscribe



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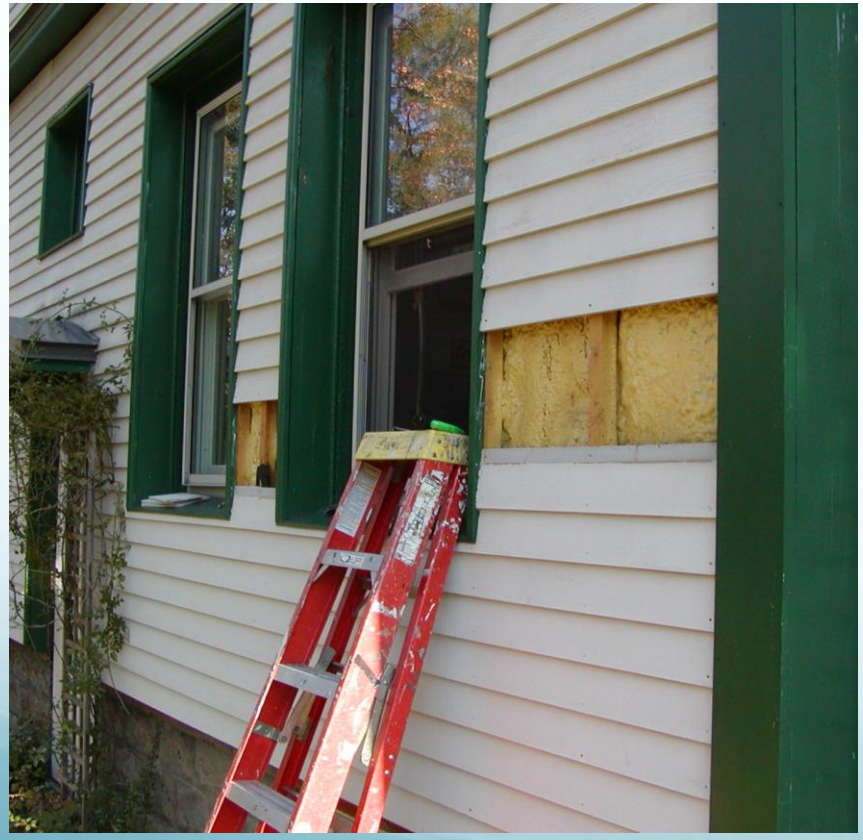
27,920

The role of monitoring in remodeling

Trim screw cladding removal



Sustained adhesion

The role of monitoring in remodeling

No cap break

Moisture content of joists

Summary

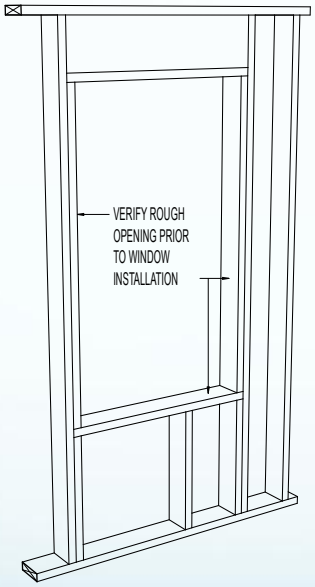
- Three continuous, comprehensive barriers: bulk water, air, thermal
- Design for drying (vapor profile)
- Weatherlap everything, back up adhesives with mechanical fastening
- Lots of considerations for WRB & window location – just be sure to connect them
- No single way to skin the cat, mock up everything

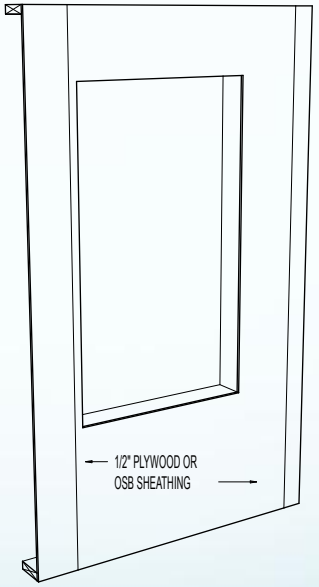
BuildingGreen, Inc.

- Founded in 1985
- Based in Brattleboro, Vermont
- 20 employees
- Supported by subscriptions, book sales, online memberships
- Does not carry advertising

BuildingGreen offices in the old Estey Organ Factory, Brattleboro

"Regular" Best Practice





FLANGED WINDOW INSTALLATION // WATER MANAGED //
BUILDING PAPER // STEP 1

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Scale: 1/2" = 1'-0"

6-00121

FLANGED WINDOW INSTALLATION // WATER MANAGED //
BUILDING PAPER // STEP 2

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Scale: 1/2" = 1'-0"

6-00122

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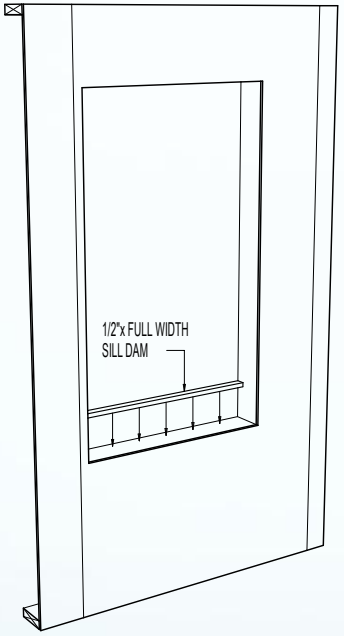

FLANGED WINDOW INSTALLATION // WATER MANAGED //
BUILDING PAPER // STEP 3

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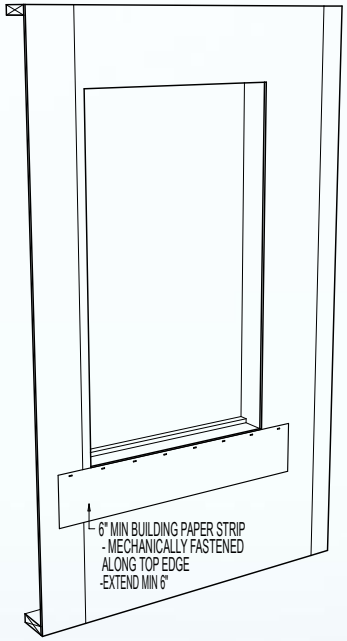

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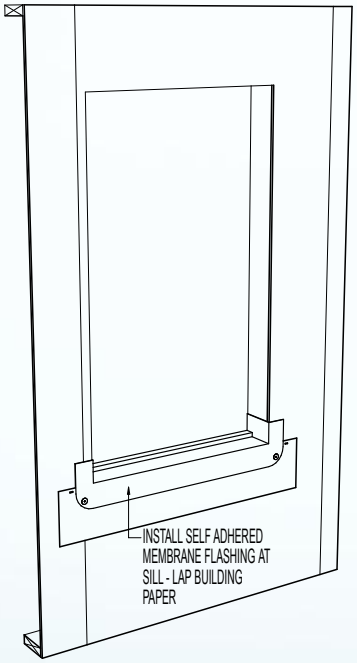

FLANGED WINDOW INSTALLATION // WATER MANAGED // BUILDING PAPER // STEP 5

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Scale: 1/2" = 1'-0"

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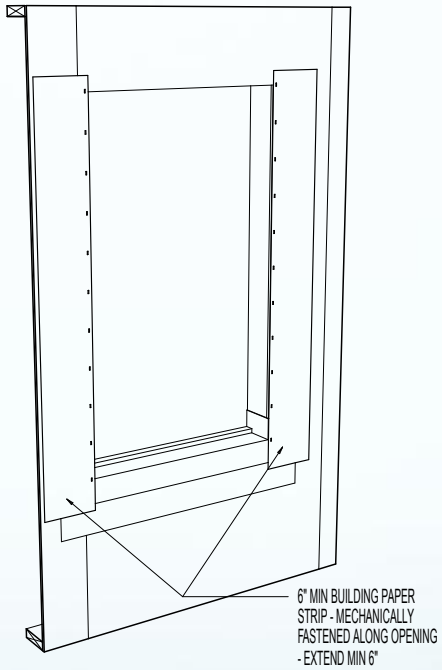

FLANGED WINDOW INSTALLATION // WATER MANAGED // BUILDING PAPER // STEP 6

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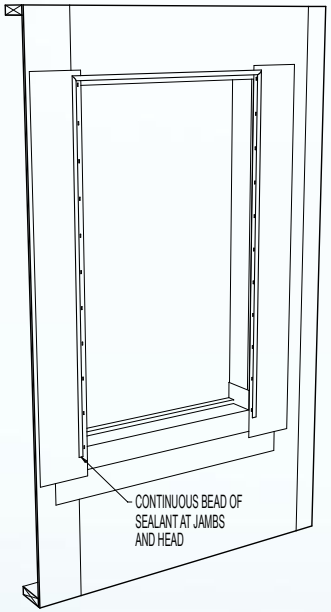

FLANGED WINDOW INSTALLATION // WATER MANAGED //
BUILDING PAPER // STEP 7

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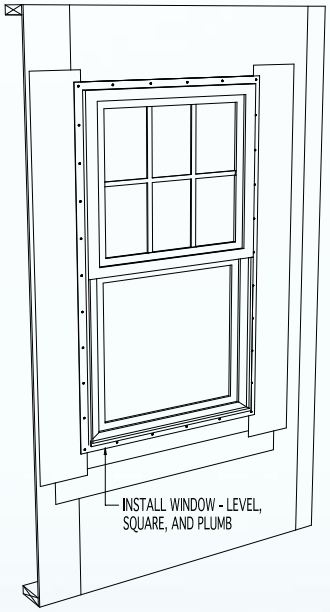

FLANGED WINDOW INSTALLATION // WATER MANAGED //
BUILDING PAPER // STEP 8

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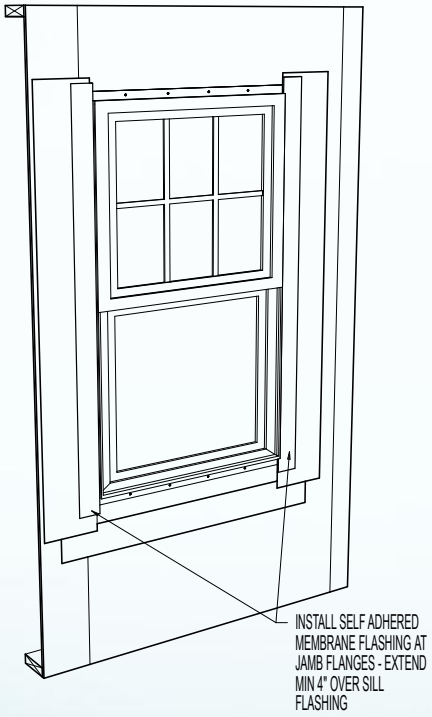

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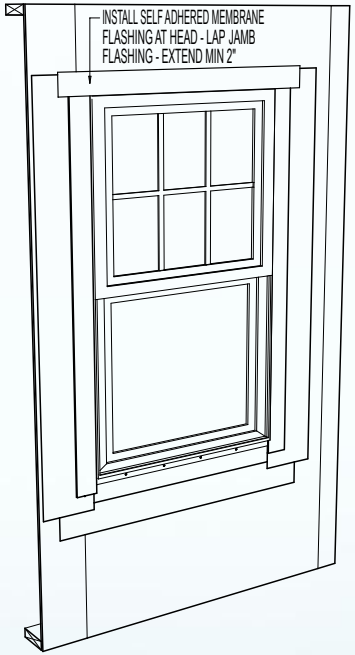

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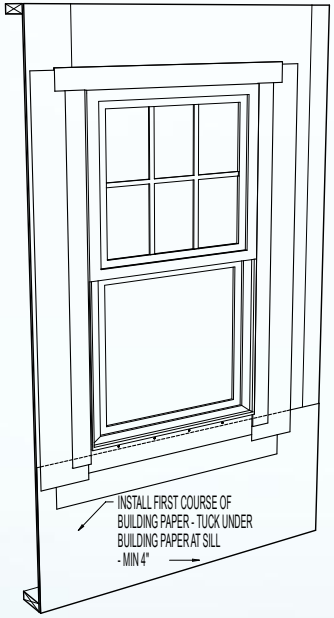

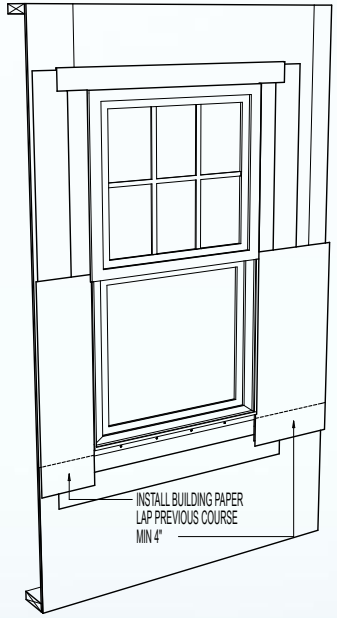

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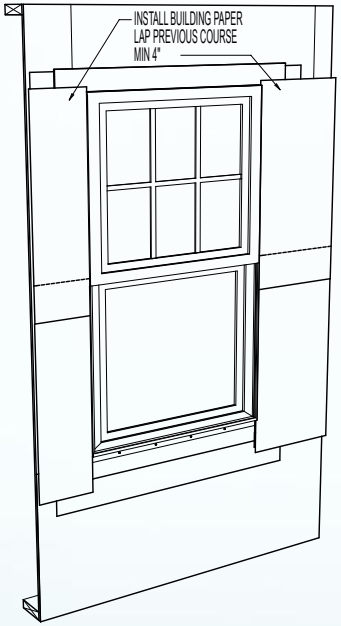

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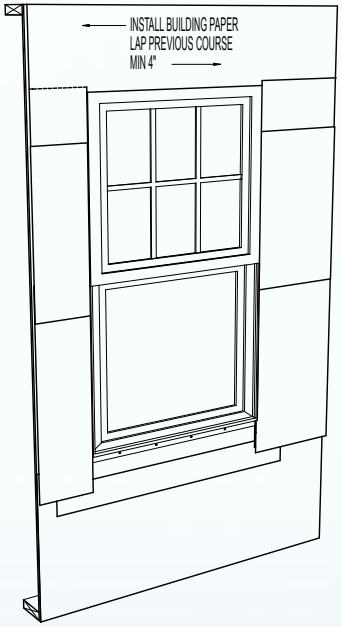

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BUILDING PAPER // STEP 14

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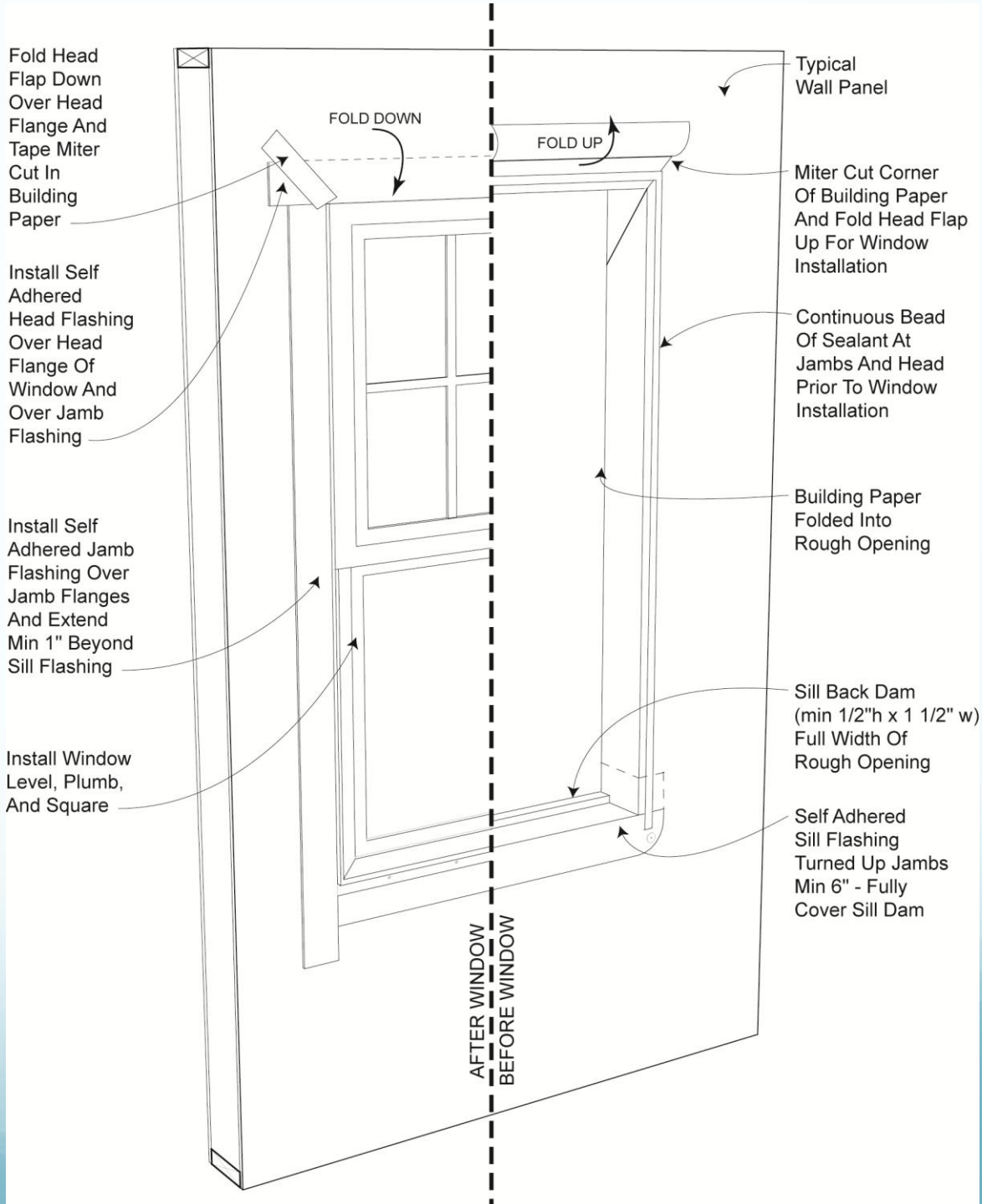
6-00134

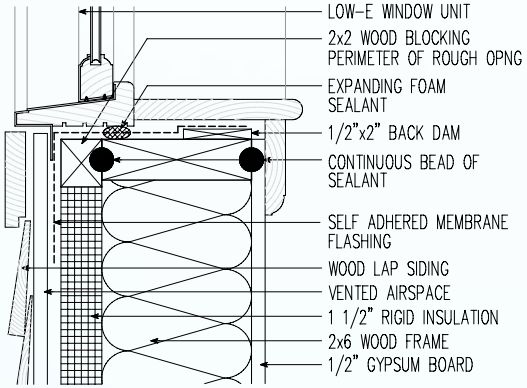
Window first? Rough opening?

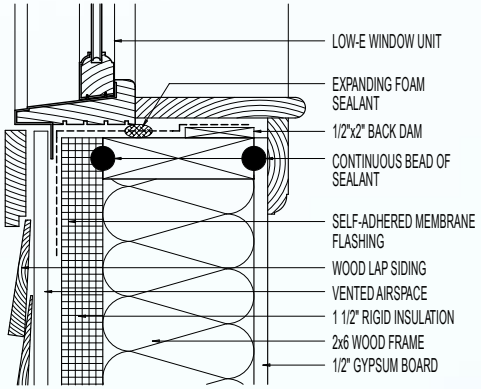


Best Practices, cont'd

- Water-manage both RO and unit installation
- WRB goes up first, typically
- Weatherlap everything
- Mechanically support adhesives

1.5-inch exterior rigid - sill





WINDOW SILL // NAILING FLANGE // 2x2 WOOD BLOCKING // WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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Scale: 3" = 1'-0"

3-00201

WINDOW SILL // NAILING FLANGE // WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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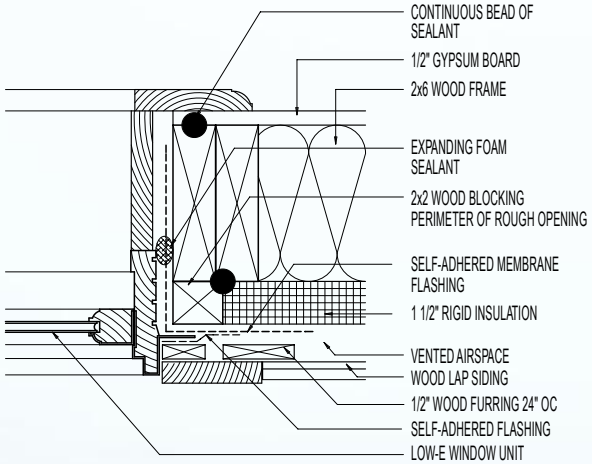
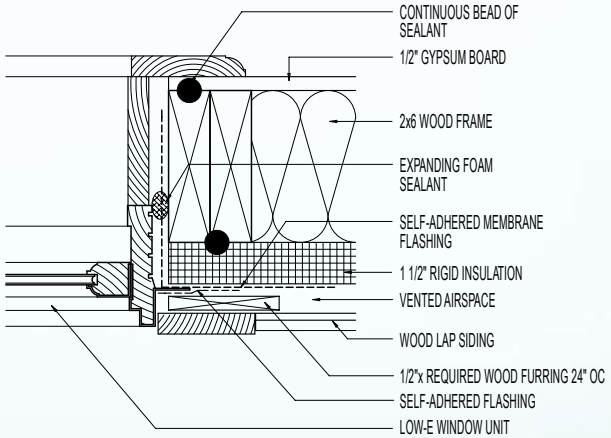
Scale: 3" = 1'-0"

3-00204

1.5-inch exterior rigid - jamb





WINDOW JAMB // NAILING FLANGE // 2x2 WOOD BLOCKING //
WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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Scale: 3" = 1'-0"

3-00202

WINDOW JAMB // NAILING FLANGE //
WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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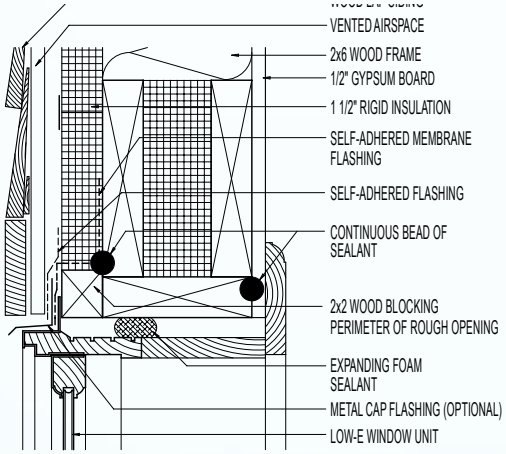
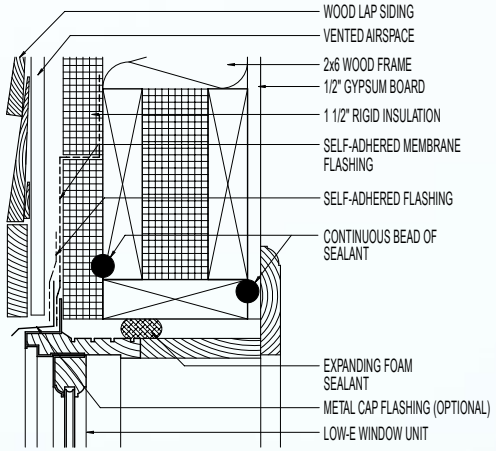
Scale: 3" = 1'-0"

3-00205

1.5-inch exterior rigid - head





WINDOW HEAD // NAILING FLANGE // 2x2 WOOD BLOCKING //
WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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Scale: 3" = 1'-0"

3-00203

WINDOW HEAD // NAILING FLANGE //
WOOD LAP SIDING // 1 1/2" RIGID INSULATION

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Scale: 3" = 1'-0"

3-00206