A hot new green cottage industry: Knitting tea cozies that go over houses and act as insulation.
DESIGNING WITH EXTERIOR INSULATION

- Exterior insulation becoming more popular and commonplace
- “Inefficient use of structural materials”
- Insulation simplifies the wall and is better building science
- Design considerations
  - Fire, Permeability, Moisture, structural, thermal, and workability
FIRE

- Protection of Foam Plastics
- 3.1.4. Combustible Construction
- Foams can be used in buildings up to 3 stories
- Testing available to allow foams to be used in buildings up to 6 stories
- There are other considerations for use of combustible products
CAN/ULC –S134 / S101
S 101 FIRE TEST

• Tests wall assembly - cladding to sheathing
• Test to ensure integrity of wall cladding for up to 6 stories
• 15 minute stay in place test, ensure cladding stays in place
• Certain company passed at 6” thick
EXTERIOR INSULATION PERMEABILITY

- Permeable or Impermeable? Both work
- ‘Design for product that you are using’
- Inboard Outboard Ratio table for Exterior Insulation (9.25.5.2)
  - Dependent on amount of in to out-board insulation relative to heating degree days to ensure no dew point issues
- Thin: use permeable, thick: impermeable works
- We are at a PH convention, is anyone using thin insulation on the outside?
- Separate advantages to impermeability, so take advantage of them
IMPERMEABLE ADVANTAGES

- Minimal if any wind washing (with proper detailing)
- Minimal moisture absorption compared to fibrous/permeable products
- Can double as air barrier
  - With proper detailing
Note: *Values are for generic insulation products. Where a specific insulation product is used in the assembly, the thermal resistance value, or long term thermal resistance value, where applicable, of that product is permitted to be used as reported by the Canadian Construction Materials Centre (CCMC) in the evaluation of such a product. "The building code does not require furring behind fibre-cement; however please refer to the specific fibre-cement manufacturer instructions for drainage space requirements. "Sheathing membrane material must comply with CAN/CGSB-09.32, "Sheathing Membrane Breather Type."*
WHY NOT DO BOTH?

• Why not have a product that is impervious to moisture and wind, while still allowing wall to vent?

• Introducing the drainage plane.

• A very small space between the sheathing and the exterior insulation
Phase 4 Testing

Variations to exterior sheathing:

- **Wall 1**: CONTROL – no exterior insulation.
- **Wall 2**: 1½” XPS foam, taped joints.
- **Wall 3**: 1½” XPS foam, taped, DrainWrap®.
- **Wall 4**: 1½” XPS foam, taped, Huber Zip®.
- **Wall 5**: 1½” f.f. polyiso, with ⅛” drainspace
  - and 2” closed cell sprayfoam to interior face
- **Wall 6**: 1½” f.f. polyiso, taped joints.
- **Wall 7**: 1½” f.f. polyiso, taped, ⅛” drainspace.
Conventional Approach
Drain Space: 0 to 1/32” (<1 mm)
Efficiency = 1 to 60%

Drainage Facers
Drain Space: ≥1/16 (>1.5 mm)
Efficiency = 60 to >90%

Drainage Channels
Drain Space: ≥1/8 (>3 mm)
Efficiency = >90%
“A small gap (1/4” or 6mm) with a vapour diffusion path to the bottom of a 10 foot wall allows enough moisture to diffuse to the exterior, so that a wall with polyiso behaves the same as a wall with mineral wool.”
- Drainage plane allows for exterior venting
- Negligible difference made to R Value
PERMEABILITY ISSUES

• Some insulations are more susceptible to moisture than others
• Where there is a rain screen, there is going to be rain
• Better be safe than sorry
• If moisture gets in, takes a long time to dry out
Dr. Steven Badger, Ph.D.

Water has a Thermal Conductivity almost twenty times higher than the conductivity of the average thermal insulation.
Figure 3: R-Value Recovery After Exposure

- **Measured R-value**
- **Labeled R-value**

The graph shows the recovery of R-value over time after exposure. The measured R-value increases gradually over time, reaching a peak at around 200 hours. The labeled R-value remains constant at 4.0 R-value per inch throughout the time period.
Dr. Michael A LaCasse

Acceptable building performance is heavily dependent on quality of workmanship.

Even the best designed wall assembly having high quality materials will none the less fail prematurely if any given vapour and air layer is not properly installed (continuous) and not adequately sealed.

It is therefore prudent to establish a quality assurance protocol during construction to help prevent the occurrence of defective insulation practices.
Insulation Gaps

WIND WASHING
Effective R-Values

Open Pore Fibrous Insulation

↓ 1 – 30%
Surface / Open Pore Flow

↓ 4 – 46%
Back Gaps

↓ 6 – 32%
Edge Gaps

↓ 15 – 64%
Back + Edge Gaps

DOGGETT, PH. D.
Effective R-Values

Closed Pore Cellular Insulation

- Surface/Open Pore Flow: ↓ 1 – 3%
- Back Gaps: ↓ 1 – 4%
- Edge Gaps: ↓ 5 – 34%
- Back + Edge Gaps: ↓ 5 – 71%

DOGGETT, PH. D.
STRUCTURAL INTEGRITY WITH THICK EXTERIOR INSULATION

• Lots of different ways to attach exterior insulation and cladding
• Long fasteners are one of the best thermal and practical option
• Keep in mind compression issues depending on what exterior insulation
<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type and Minimum Size</th>
<th>Minimum Penetration into Wall Framing (inches)</th>
<th>Fastener Spacing in Furring (inches)</th>
<th>Maximum Thickness of Foam Plastic Insulating Sheathing (inches)</th>
<th>Allowable Wind Pressure Resistance (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 1x3 Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>Nail (0.120&quot; shank; 0.271&quot; head)</td>
<td>1 1/4&quot;</td>
<td>8</td>
<td>2 psf 1.5 psf 0.5 psf 2 psf 1 psf 0.5 psf 2 psf 1 psf 0.5 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 42.6 psf 28.4 psf 18.9 psf 24&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 21.3 psf 14.2 psf</td>
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<tr>
<td>Minimum 1x3 Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>Nail (0.131&quot; shank; 0.281&quot; head)</td>
<td>1 1/4&quot;</td>
<td>8</td>
<td>2 psf 1.5 psf 0.5 psf 2 psf 1 psf 0.5 psf 2 psf 1 psf 0.5 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 46.5 psf 31.0 psf 21.3 psf 20.7 psf 24&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 31.0 psf 20.7 psf</td>
</tr>
<tr>
<td>Minimum 1x3 Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>#8 wood screw</td>
<td>1&quot;</td>
<td>12</td>
<td>3 psf 2 psf 0.5 psf 3 psf 1 psf 0.5 psf 3 psf 1 psf 0.5 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 98.9 psf 66.0 psf 49.5 psf 24&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 74.2 psf 49.5 psf</td>
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<tr>
<td>Minimum 1x3 Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>1/2&quot; lag screw</td>
<td>1 1/2&quot;</td>
<td>24</td>
<td>3 psf 0.75 psf 2 psf 3 psf 0.75 psf 2 psf 3 psf 0.75 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 35.1 psf 23.4 psf 140.4 psf 93.6 psf 24&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 79.0 psf 52.7 psf</td>
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<tr>
<td>Minimum 33mil Steel Hat Channel or Minimum 1x3 Wood Furring</td>
<td>33 mil Steel Stud</td>
<td>#8 screw (0.285&quot; head)</td>
<td>1/2&quot; steel thickness +3 threads</td>
<td>12</td>
<td>3 psf 1.5 psf 0.5 psf 3 psf 1.5 psf 0.5 psf 3 psf 1.5 psf 0.5 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 52.9 psf 35.3 psf 49.5 psf</td>
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<td>1/2&quot; steel thickness +3 threads</td>
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<td>4 psf 2 psf 1 psf 4 psf 2 psf 1 psf 4 psf 2 psf 1 psf</td>
<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 62.9 psf 41.9 psf 52.9 psf</td>
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<td>16&quot; o.c. Furring: 3 psf 11 psf 25 psf 2 psf 11 psf 25 psf 51.8 psf 34.5 psf 49.5 psf</td>
</tr>
</tbody>
</table>

Table 1b: Furring Minimum Fastening Requirements for Application Over Foam Plastic Insulating Sheathing to Support Cladding System Weight and Resist Wind Pressure

For St. 1" = 25.4 mm; 1 pound per square foot (psf) = 0.0479 kPa. DR = design required
Figure 2: SIP TP or SIP LD into Wood Studs

Table 2a: Recommended Fastener Spacing for SIP TP and SIP LD Fasteners When Used to Support the Shear Load of Various Insulation Thickness and Assembly Weights into Wood Framing

<table>
<thead>
<tr>
<th>Horizontal Fastener Spacing, s (in. oc)</th>
<th>Insulation Assembly Thickness, t (in.)</th>
<th>Shear Strength, V (lbf/fastener)</th>
<th>Vertical Fastener Spacing, g (in. oc)</th>
<th>Maximum Insulation Assembly Weight to be Supported (psf)</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td>5</td>
<td>7.5</td>
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<td>15&quot;</td>
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<td></td>
<td>6</td>
<td>11.0</td>
<td>12&quot;</td>
<td>8&quot;</td>
</tr>
</tbody>
</table>
• Not just cladding weight
• Seismic
• Wind / Suction
• Certain company got engineered report for fastening 6” exterior insulation up to 6 stories (same who did S101)
• Stamped by Morrison Hershfield Engineers
Hey, would you mind changing the air tightness from 0.6 ACH50 to 0.05 CFM50?

Whatever man... It's your house.
Innovative Insulation Solutions

Raymond Belanger
Technical Representative
250.490.1599
RaymondB@QuikTherm.com

Derek Snitynsky
Regional Director
250.863.3653
Derek@QuikTherm.com

THANK YOU!
AN OVERVIEW OF STUDIES TO ASSESS THE THERMAL AND HYGROTHERMAL PERFORMANCE OF HIGHLY INSULATED AND ZERO ENERGY READY WALL ASSEMBLIES

Michal Bartko¹, PhD., Robert Jonkman¹, P.Eng., Michael A. Lacasse², PhD., P.Eng., Travis Moore³ BSc Eng., Anil Parekh⁴, MASc., Silvio Plescia⁵, P.Eng.

It can be summarized that mineral fiber based thermal insulation performs better in dry climates (Edmonton, Yellowknife) whereas XPS foam insulation outperforms if used in walls located in humid climates (Vancouver, St. John’s).
It is perhaps self-evident to note that acceptable building performance is heavily dependent on the quality of workmanship. Even the best designed wall assembly having high quality materials will nonetheless fail prematurely if any given vapour or air barrier layer is not properly installed (continuous) and not adequately sealed. It is therefore prudent to establish a quality assurance protocol during construction to help prevent the occurrence of defective installation practices.