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Evaluation of an Interior Air Barrier System with Dynamic Water Vapor Control in North American Climates

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AIVC Conference, Washington, DC - April 18, 2013

Agenda

- What is a smart vapor retarder?
- Dynamic water vapor permeance
- Physical property durability protocol
  - Water vapor permeance
  - Air permeance
  - Tensile strength
- Large scale air barrier system performance testing
- Hygrothermal analysis example

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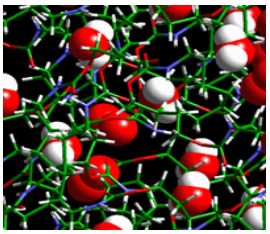
What is a Smart Vapor Retarder (SVR)?

- A 2 mil (50 µm) polyamide (nylon) air impermeable, plastic film
- Nylon and water molecules are negatively charged
- At 60% RH a water molecule's charge exceeds that of 2 mil polyamide film forcing apart the polymer chains
- The chains close when the RH drops below 60%



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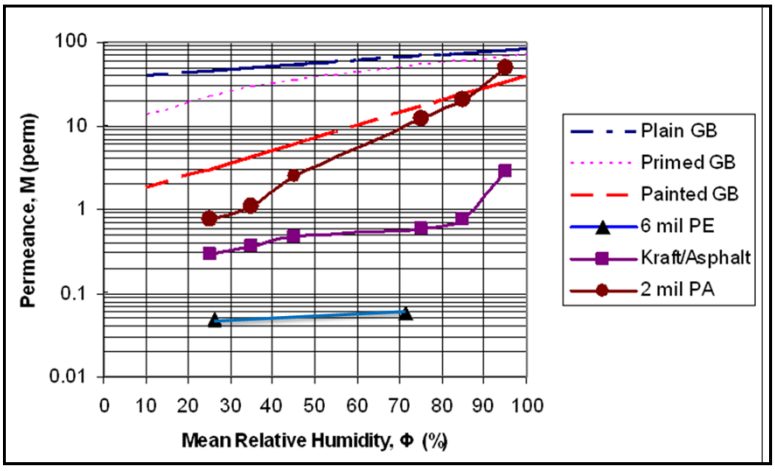
Water Vapor Permeance of Six Common Interior Wall Materials



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NRC Canada Evaluation Durability Protocol

- Q-UV apparatus (UVA-340 lamps) operated in accordance with ASTM G 53
- One cycle equivalent to:
  - 8 hours of UV radiation at 60°C
  - 4 hours of condensation at 40°C
- UV Exposure
  - Level 1 – 48 h (4 cycles)
  - Level 2 – 72 h (6 cycles)
- Heat ageing at 90°C using ASTM D 3045
  - 168 h (1 week)
  - 336 h (2 weeks)

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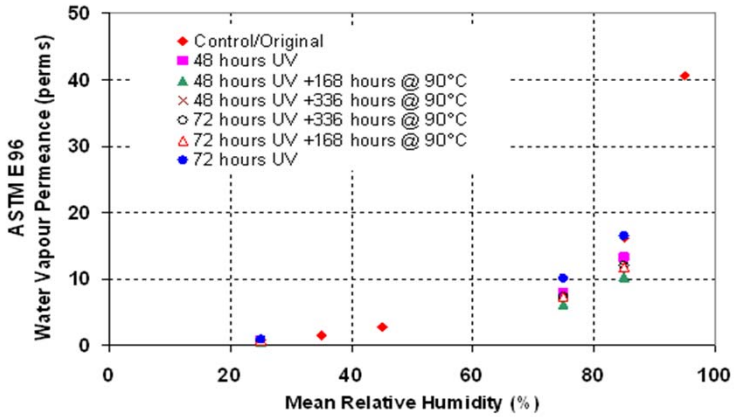
2 mil SVR Water Vapor Permeance Data Using Durability Protocol



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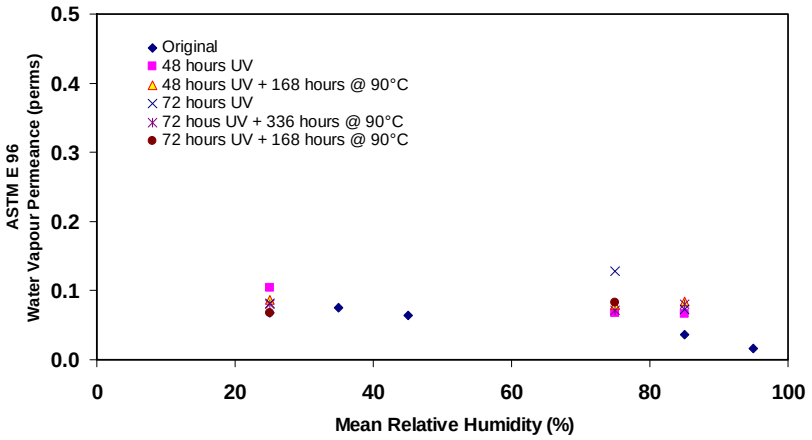
6 mil PE Water Vapor Permeance Data Using the Durability Protocol



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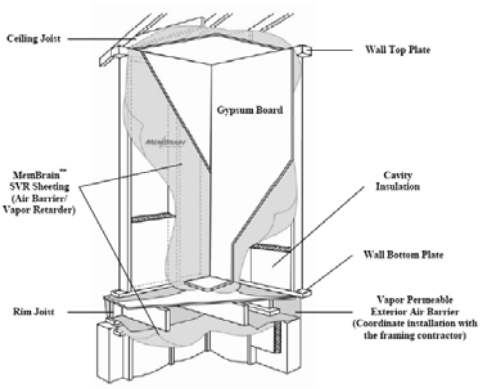
Mechanical Property Results Using Durability Protocol

- Mechanical, water vapor permeance and air permeance properties do not change under controlled and prolonged laboratory simulated extreme exposure conditions
- Overall accelerated weathering performance of SVR is found to be equivalent or better compared to traditional 6-mil polyethylene to function as dual vapor and air barrier
- Tensile strength of SVR was 2 to 4 times greater than 6 mil polyethylene with the same extreme exposure conditions
- SVR material is sensitive to long-term extreme environmental exposure conditions, not applicable for indoor applications, comprising of ultra-violet (UV) light and elevated temperature

Smart Vapor Retarder
Interior Air Barrier System



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Large-Scale Lab Testing
ASTM E 283 Test Method

National Research Council Canada | Conseil national de recherches Canada

Institute for Research in Construction | Institut de recherche en construction

CCMC 13278-R

CCMC EVALUATION REPORT

DIVISION 07264
Issued 2007-06-27
Re-evaluation due 2010-06-27

MemBrain ™– Vapour Barrier and Air Barrier System

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1. *Purpose of Evaluation*
The proponent sought confirmation from the Canadian Construction Materials Centre (CCMC) that "MemBrain™" can serve as an alternative solution to polyethylene film as a vapour barrier and an air barrier system within the exterior walls of the building envelope, in compliance with the National Building Code of Canada (NBC) 2005.

2. *Opinion*
Subject to the limitations and conditions stated in this report, test results and assessments provided by the proponent show that "MemBrain™" complies with CCMC's Technical Guide for Vapour Barrier with RH-Dependent Water Vapour Permeance, MasterFormat number 07264, dated 07-05-24, which also references CCMC's Technical Guide for Air Barrier Systems for Exterior Walls of Low-Rise Buildings, MasterFormat number 07272, dated 96-02-09. "MemBrain™" can serve as an alternative solution that will achieve at least the minimum level of performance for vapour barriers and air barrier systems with respect to condensation control required in:

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CCMC Tech Guide 07272 / ASTM E 2357
Air Barrier System Evaluation

- Air Leakage Tests @ 75 Pa (25 mph)
- (Positive & Negative Loading Cycles)
  - Sustained load (1 hour each) at 600 Pa (70 mph)
  - Cyclic load (1000 3 s cycles each) at 800 Pa (80 mph)
  - Gust load (3 s each) at 1200 Pa (100 mph)

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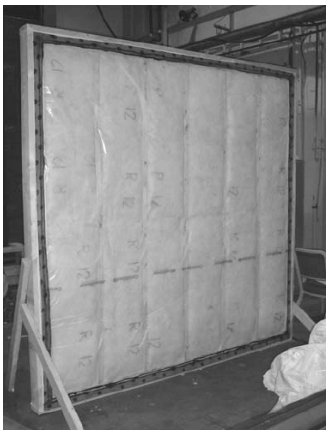
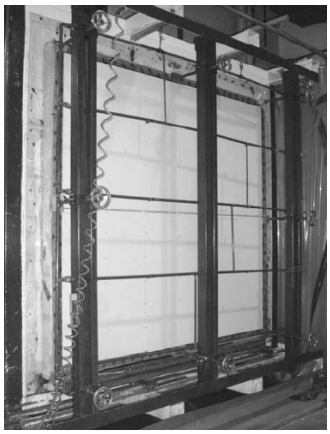
CCMC MemBrain Test Specimen #1

Opaque Wall System





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CCMC MemBrain Test Specimen #2

Window & Penetrations Wall System

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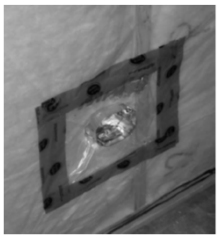
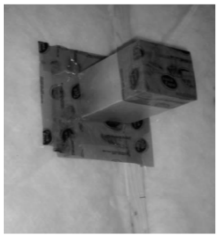
Wall Penetrations





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CCMC MemBrain Test Specimen #3

Opaque Wall System with Vertical Seam

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CCMC SVR Air Barrier System Results

ASTM E 2357 [Code Requirement of 0.04 cfm/ft²]

Wall Test Specimen	Air Flow Direction	Original Air Leakage (cfm/ft²) [L/s/m²]	After Structural Leakage (cfm/ft²) [L/s/m²]
06-06-M0230-1	**-**	**0.006 [0.030]**	**0.008 [0.038]**
(Opaque Wall)	**+**	**0.009 [0.045]**	**0.010 [0.050]**
06-06-M0230-2	**-**	**0.006 [0.032]**	**0.014 [0.069]**
(Penetrations Wall)	**+**	**0.006 [0.030]**	**0.014 [0.069]**
06-06-M0230-3	**-**	**0.008 [0.038]**	**0.010 [0.047]**
(Vertical Seam Wall)	**+**	**0.007 [0.034]**	**0.007 [0.036]**

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Hygrothermal Analysis
Performance Example

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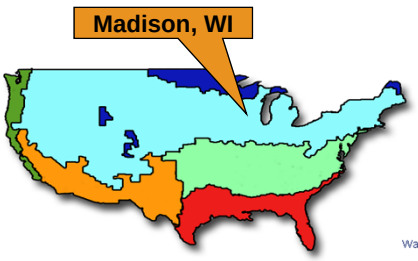
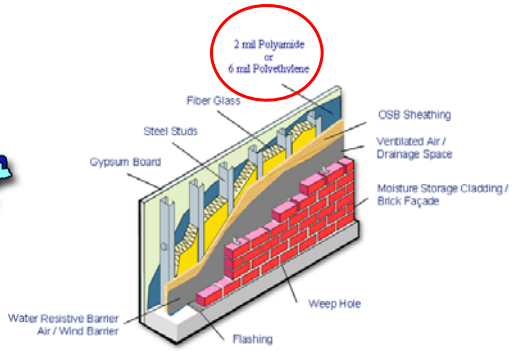
Hygrothermal Analysis Example
Interior Vapor Control Strategy Comparison





Madison, WI Location
East Facing Brick Façade Wall

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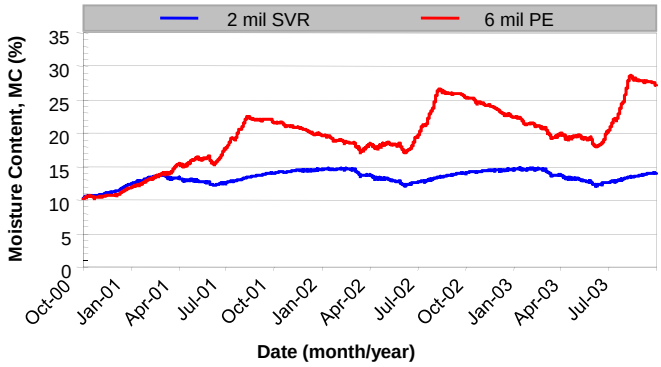
OSB Sheathing Analysis
Moisture Content Comparison



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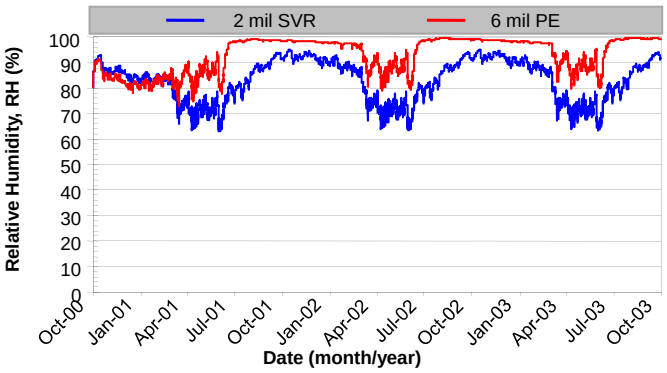
OSB Sheathing Analysis
Surface Condensation Comparison



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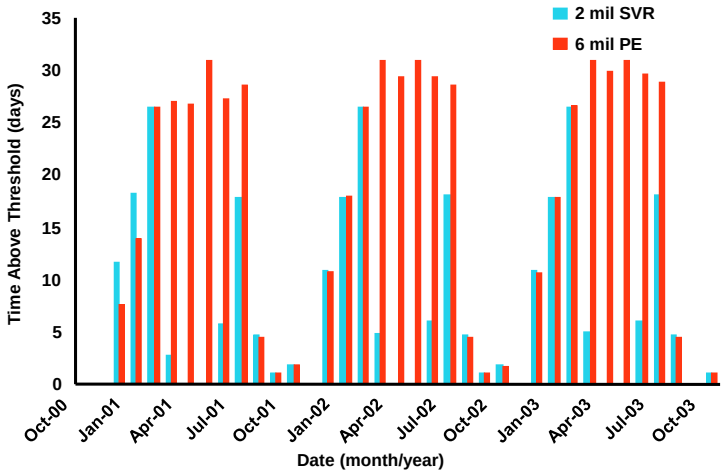
OSB Sheathing Analysis
Mold Growth Risk Comparison



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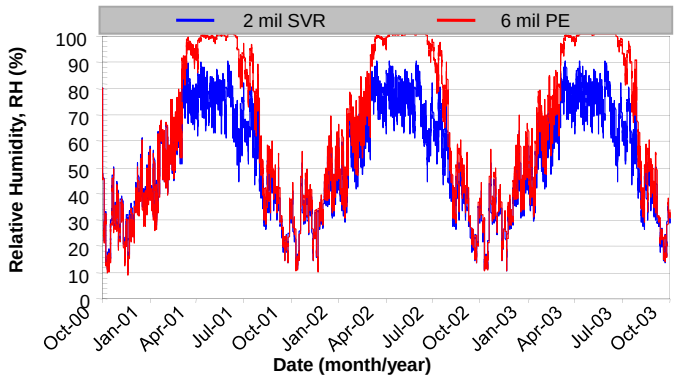
Interior Vapor Retarder Analysis
Surface Condensation Comparison



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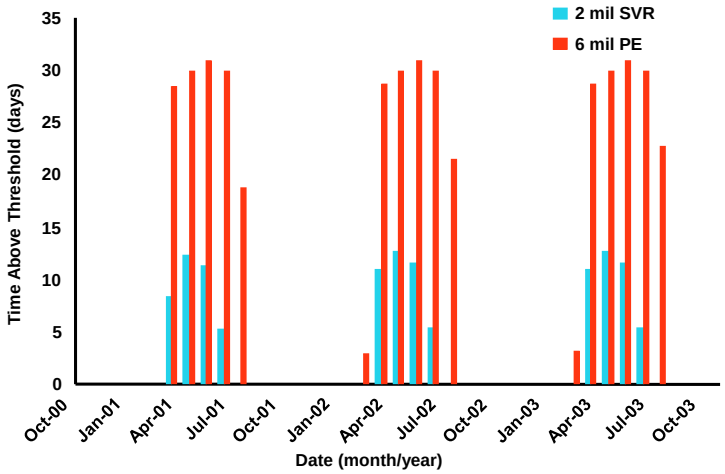
Interior Vapor Retarder Analysis
Mold Growth Risk Comparison



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Question & Answer Session

Thank you for your attention!

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