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Institute for Research in Construction
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CCMC 13278-R

CCMC *EVALUATION REPORT*

DIVISION **07264**
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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:

- NBC 2005, Sentences 9.25.4.2.(1), (2) and (3), and Articles 9.25.3.1., 9.25.3.2. and 9.25.3.3.

Canada Mortgage and Housing Corporation permits the use of this product in construction financed or insured under the *National Housing Act*.

3. Description

The "MemBrain™" product is a 0.05-mm-thick (2-mil-thick) polyamide-6 (nylon-6) film. It is available in folded widths of 2.44 m, 2.74 m, 3.05 m and 3.66 m, which are 30 m in length.

This report addresses the performance of "MemBrain™" as an alternative solution to replace polyethylene film installed on the warm side of the exterior wall assembly, as the designated vapour barrier and as the air barrier system.

When used as the air barrier system, the following CertainTeed-specified "MemBrain™" components and accessories are required:

- "MemBrain™" 0.05-mm-thick film as the principal material in the plane of airtightness;
- Accessories for continuity consist of:
  - For sealing the joints of "MemBrain™," Tremco, Tremflex 834, siliconized acrylic latex sealant shall be used as a specified caulking sealant conforming to CAN/CGSB-19.0-M77 (ASTM C 834), or equivalent acoustical or silicone-based sealants conforming to ASTM C 920 or C 834 shall be used.
  - CCMC-evaluated sheathing tape for small discontinuities in the plane of airtightness;
  - A one-component, spray-in-place polyurethane foam sealant, evaluated by CCMC (i.e. CCMC 13074-R) or listed by CCMC under CAN/ULC-S710.1-05 and CAN/ULC-S710.2-05 shall be used for relevant contact surfaces around window and door penetrations. The sealant shall be qualified to seal vinyl and wood as a minimum (see CCMC 13074-R); and
  - "MemBrain™" 0.05-mm-thick film to be installed at ceiling locations; and
- For strength to resist wind forces, "MemBrain™" shall be fastened to the supporting structure with staples onto studs and supported by gypsum wallboard on one side and insulation on the other (as with polyethylene sheet air barrier).

4. Usage and Limitations

Vapour Diffusion Control – Designated Vapour Barrier

As the designated vapour barrier installed on the warm side of an exterior wall assembly, the NBC 2005 requires a water vapour permeance (WVP) that is not greater than 60 ng/Pa·s·m^2 for indoor spaces maintained below 35% relative humidity (RH) over the heating season. For indoor spaces maintained over 35% RH or over 60% RH, and depending on the mild climate indicator, the vapour barrier WVP must be designed in accordance with Part 5 of the NBC 2005.

The "MemBrain™"film has a WVP that is dependent on the ambient RH, so it is a dynamic WVP that changes with the ambient conditions within the exterior wall cavity (see Figure 1).

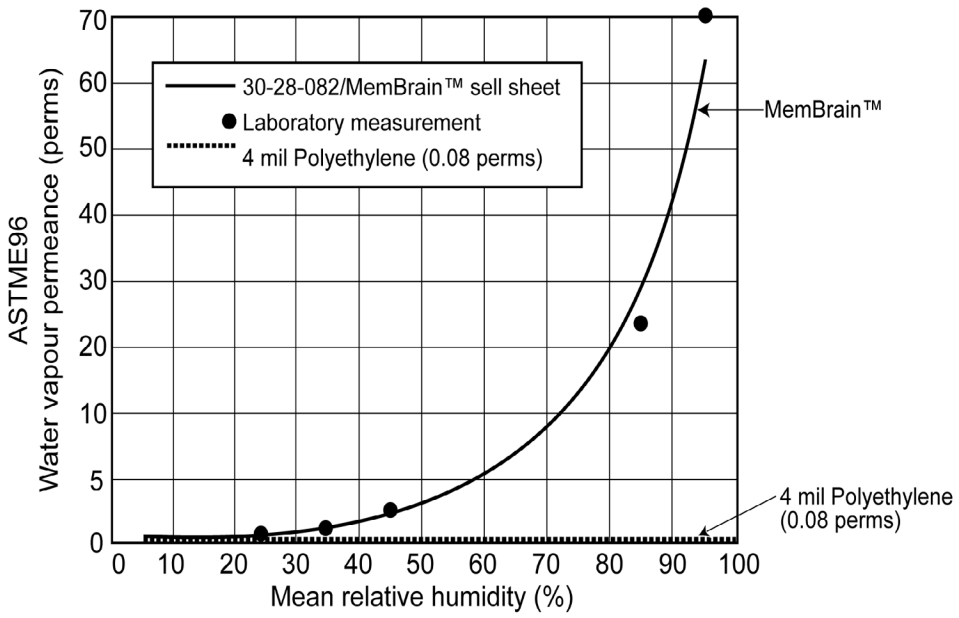

Figure 1. Water Vapour Permeance of "MemBrain™" compared to 4 mil polyethylene. (1 Perm = 57.45 ng/Pa·s·m^2)

Background

Figure 1 illustrates that the WVP of "MemBrain™" increases exponentially as the ambient RH increases. Hence as the WVP increases within the wall cavity, water vapour may diffuse through the interior drywall into the interior space.

This varying WVP required computer modeling to verify compliance of the NBC 2005 with the principles of Part 5. The modeling parameters and wall assumptions are presented in Section 5. The moisture content of both the wood-based sheathing and interior drywall was the focus of the modeling.

The limitations in the use of "MemBrain™" as the designated vapour barrier are:

i) The "MemBrain™" film shall be protected from direct ultraviolet (UV) exposure and covered with interior gypsum wallboard within seven days;

ii) The wood-frame wall assembly shall have a maximum 12.5-mm (11.1 mm typ.) exterior wood-based sheathing installed with joints at stud locations (i.e. no open horizontal joints; 2 layers of sheathing paper 'only' is not permitted);

iii) For locations with a Moisture Index (MI) < 1.0, the interior drywall shall be painted with a primer and two coats of latex paint (1 100 ng/Pa·s·m^2) or acrylic paint (400 ng/Pa·s·m^2);

iv) For locations with a MI > 1.0, the interior drywall shall be painted with a primer and two coats of latex paint (1 100 ng/Pa·s·m^2) or acrylic paint (400 ng/Pa·s·m^2), except where there is a potential for rain penetration into the wall cavity(1) in which case only primer and two coats of latex paint shall be applied;

v) Highly water-vapour-resistant interior wall finishes shall be avoided (such as ceramic wall tile and vinyl wall paper).

(1) The cladding and second plane of protection required by the NBC 2005 would be considered to have failed if moisture due to rain penetration finds its way into the wall cavity. In this scenario, the

exposure of the drywall backing to moisture is equivalent to the level of performance/risk provided by the airtight drywall approach, which is an acceptable solution in the NBC 2005.

Air Leakage Control – Designated Air Barrier System

The "MemBrain™" air barrier system has demonstrated sufficiently low air permeance, when installed as an alternative to the conventional 0.15-mm (6-mil) polyethylene sheet, to meet the objectives and functional statements of Section 5.4. and Article 9.25.3.2. of Division B of the NBC 2005. This conformance applies for buildings with an indoor environment of 20°C and a winter design RH of 35% or other relative humidities as covered in the vapour diffusion control review above for the respective regional moisture index.

The "MemBrain™" air barrier system has demonstrated sufficient strength as required in Article 9.25.3.2. of Division B of the NBC 2005 to be used for low-rise buildings in geographical locations where the Q_{10} or Q_{50} value does not exceed 0.60 kPa. (The Q_{10} or Q_{50} value is the hourly wind pressure for a 1-in-10-year or 1-in-50-year return period found in Appendix C of Division B of the NBC 2005.)

The CertainTeed-specified installation details are sufficient to address the continuity details required in Article 9.25.3.3. of Division B of the NBC 2005; they essentially follow conventional practice for a polyethylene air barrier system.

To conform in terms of air leakage control, strength and continuity, the "MemBrain™"air barrier system must be:

i) protected from direct UV exposure and covered with interior gypsum wallboard within seven days;

ii) installed with the specified fasteners over wood-frame stud walls and covered with gypsum wallboard; and

iii) Installation in the field is to be done by trained installers/contractors following the conventional practice for polyethylene sheet installation and using CertainTeed-specified accessories in accordance with CertainTeed Corporation's installation manual entitled "CertainTeed MemBrain™ Smart Vapor Retarder Sheeting Air Barrier Installation Instructions for Wood Framing," dated June 2007 (the CertainTeed literature code number is 30-28-137).

The product must be identified with the following information:

- manufacturer's name or logo; and
- the phrase "CCMC 13278-R."

5. Performance

Testing to the CCMC Technical Guides for MasterFormat numbers 07264 and 07272 was conducted at an independent laboratory recognized by CCMC. The results of testing "MemBrain™" as a vapour barrier and air barrier system are summarized in Tables 1 and 2.

The "MemBrain™" air barrier system has demonstrated performance that meets the criteria of the CCMC Technical Guide for MasterFormat number 07272. To qualify, a conforming air barrier system shall:

(i) have an acceptable low air leakage rate,

(ii) be continuous,

(iii) be durable,

(iv) have sufficient strength to resist the anticipated air pressure load, and

(v) be buildable in the field.

Table 1. Testing Vapour Barrier Permeance and Durability for "MemBrain™"

Property[(1)] Testing	UV (level 1) and Heat Aging	UV (level 2) and Heat Aging	Requirement	Result
Tensile strength Water vapour permeance Air permeance	Report original values	Report original values	No more than 15% of original values, reduction in tensile strength and 15% increase in WVP and air permeance Or Percentage loss of strength or increase in WVP and air permeance no greater than control specimens	Pass
UV Testing (2 levels)	48 h	72 h[(2)]		
Tensile strength Water vapour permeance Air permeance	Report residual values after 48 h UV exposure	Report residual values after 72h UV exposure		
Heat aging 1 (of UV-exposed specimens)	168 h	168 h		
Tensile strength Water vapour permeance Air permeance	Report residual values after 48 h UV exposure and 168 h heat aging	Report residual values after 72 h UV exposure and 168 h heat aging		
Heat aging 2 (of UV-exposed and 168 h heat-aged specimens)	168 h	168 h		
Tensile strength Water vapour permeance Air permeance	Report residual values after 48 h UV exposure and 336 h heat aging	Report residual values after 72 h UV exposure and 336 h heat aging		

Notes to Table 1:

(1) The test values are too voluminous to present here. The testing protocol and criteria that was met are presented.

(2) This value is set to establish a maximum "upper end" for UV-exposure limitation.

Computer Modeling of "MemBrain™" Vapour Diffusion Control

The computer modeling was carried out with *hyg*IRC-2D, a two-dimensional hygrothermal model capable of predicting heat, air and moisture (HAM) transport in porous building materials.

In the computer modeling, two materials were selected for comparison:

1. 0.15-mm-thick poly or 60 ng/Pa·s·m^2 (minimum NBC 2005 requirement), and
2. proprietary 0.05-mm-thick polyamide (nylon-6) film.

The wall configuration is outlined below in Figure 2, and Figures 3 and 4 show the indoor conditions. The exterior conditions simulated represent the actual weather conditions for: Shearwater, NS, Vancouver, BC, Ottawa, ON and Winnipeg, MB. The interior finishes considered were painted drywall (i.e. primer and two coats of latex (1 100 ng/Pa·s·m^2) or acrylic paint (400 ng/Pa·s·m^2)) and unpainted drywall.

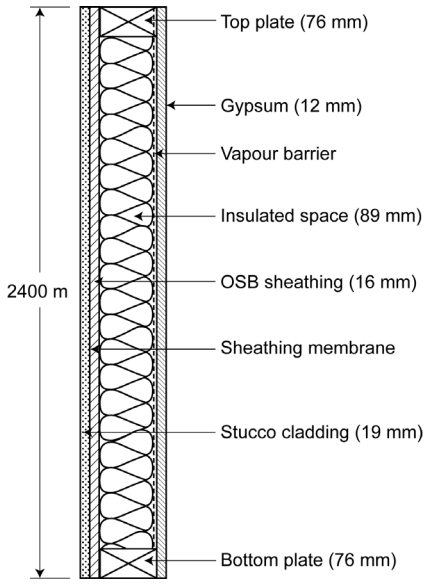

Figure 2. Stucco-Clad Wall Assembly Modeled for Vapour Diffusion Control Assessment

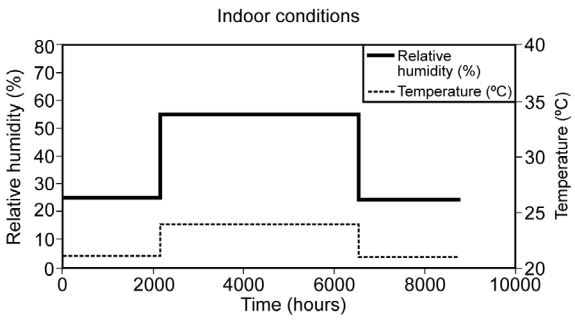

Figure 3.

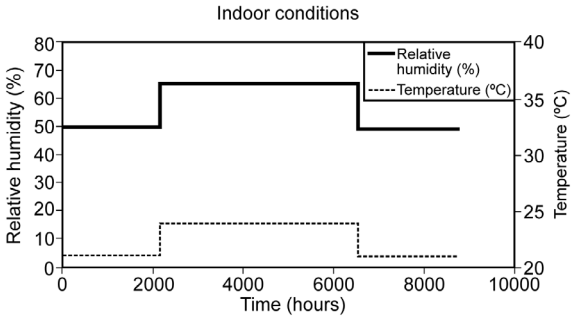

Figure 4.

Table 2. Computer Modeling Results for "MemBrain™"

Coastal Climates (MI > 1)		
Condensation location	Low Interior RH (≤ 35%)	High Interior RH (≤ 60%)
	No incidental rain penetration	
Moisture content of OSB exterior sheathing	Pass(1)	Pass
Moisture content of gypsum wallboard	Pass	Pass
	With incidental rain penetration(2)	
Moisture content of OSB exterior sheathing	Pass	Pass
Moisture content of gypsum wall board	Latex only(2)	Latex only(2)
Non-Coastal Climates (MI < 1)		
Condensation location	Low Interior RH (≤ 35%)	High Interior RH (≤ 60%)
	No incidental rain penetration	
Moisture content of OSB exterior sheathing	Pass	Pass
Moisture content of gypsum wall board	Pass	Pass
	With incidental rain penetration	
Moisture content of OSB exterior sheathing	Pass	Pass
Moisture content of gypsum wall board	Pass	Pass

Notes to Table 2:

(1) The Pass designation means the moisture content within the OSB or the interior gypsum wallboard was within a range that is deemed acceptable or is equivalent to a Code-prescribed acceptable solution (i.e. airtight drywall approach). This acceptable performance applies to interior gypsum wallboard that is painted with either a primer and two coats of latex paint (1 100 ng/Pa·s·m^2) or acrylic paint (400 ng/Pa·s·m^2).

(2) In cases where there may be incidental rain penetration, a primer and two coats of acrylic paint (400 ng/Pa·s·m^2) does not perform satisfactorily. However, the incidental rain penetration moisture would be considered a failure of the cladding system (not failure of the designated vapour barrier) and should be rectified.

Table 3. Results of Testing "MemBrain™" Air Barrier System.

Air Leakage Rate Testing		
Wood-frame Wall Specimens	Requirement	Result
Specimen no. 1 — opaque wall	Air Leakage Rate[(2)] at 75 Pa ΔP ≤ 0.05 L/(s·m^2)[(3)]	Pass
Specimen no. 2 — continuity at penetrations	Air Leakage Rate at 75 Pa ΔP ≤ 0.055 L/(s·m^2)	Pass[(1)]
Specimen no. 3 — opaque wall with vertical joint	Air Leakage Rate at 75 Pa ΔP ≤ 0.055 L/(s·m^2)	Pass

Notes to Table 3:

(1) The air leakage rate was 0.03 L/(s·m^2) before aging and 0.069 L/(s·m^2) after aging. Air leakage near ducting was determined to be the source of the leakage and revised sealing details are intended to address this defect. The air leakage values were within the acceptable test range and was deemed a pass.

(2) The air leakage rate of the specimen was determined after structural aging of the air barrier system. Structural aging of the air barrier system was conducted to qualify the air barrier system for a design structural wind load of Q_{10} or Q_{50} = 0.6 kPa (NBC 2005 climatic data in Appendix C) for a 1-in-10 or 1-in-50 year return period. The air barrier system was subjected to a loading schedule involving one hour of sustained positive and negative pressure set at 0.60 kPa, 2 000 cycles of positive and negative pressure set at 0.80 kPa, and a gust wind of positive and negative pressure of 1.2 kPa.

(3) The air leakage rate requirement is based on the following permissible air leakage rate, which is deemed to meet the intent of the NBC 2005 for air barrier system performance.

Water vapour permeance of outermost layer of wall assembly (ng/Pa·s·m^2)	Maximum permissible air leakage rates (L/s·m^2) @ 75 Pa
15 < WVP ≤ 60	0.05
60 < WVP ≤ 170	0.10
170 < WVP ≤ 800	0.15
> 800	0.20

For more information on the CCMC Technical Guide requirements and how they relate to the NBC 2005 requirements, please see the IRC 1997 publication, *Air Barrier Systems for Walls of Low-Rise Buildings: Performance and Assessment*.

Figures 5 to 9 outline typical construction details to be reproduced in the field as part of the installation of the "MemBrain™" air barrier system. The wall specimens tested were representative of these details. See "CertainTeed MemBrain™ Smart Vapor Retarder Sheeting Air Barrier Installation Instructions for Wood Framing," dated June 2007 (the CertainTeed literature code number is 30-28-137).

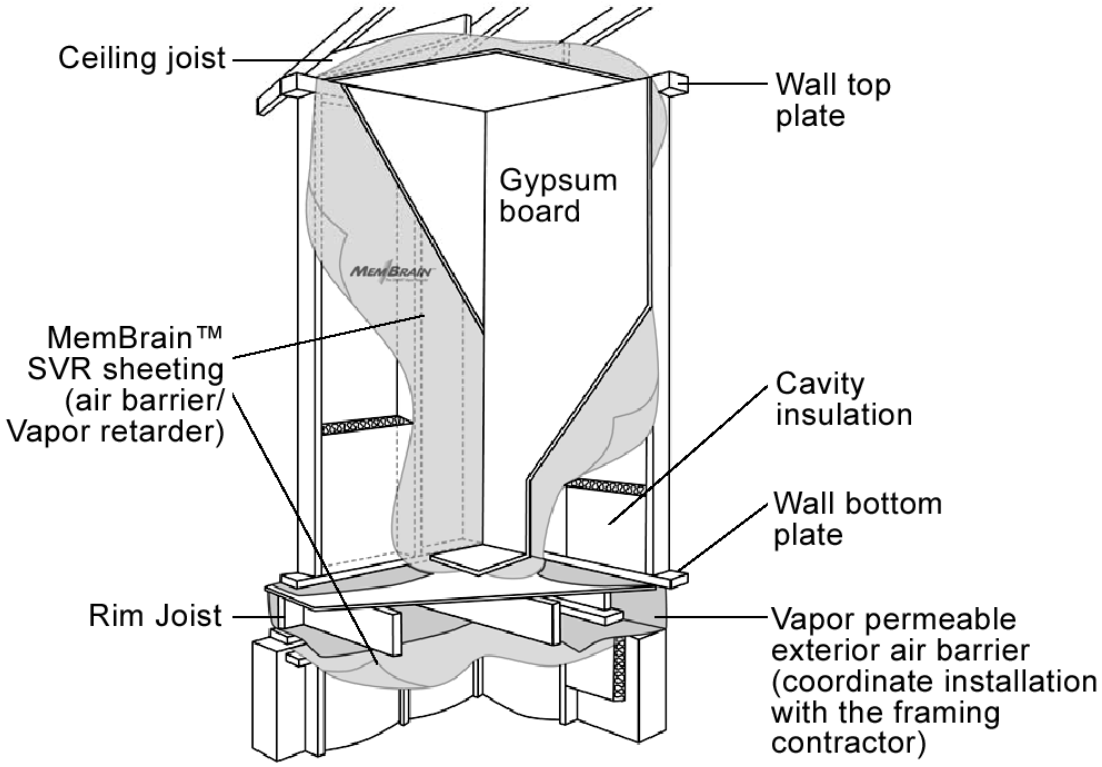

Figure 5. "MemBrain™" air barrier system.

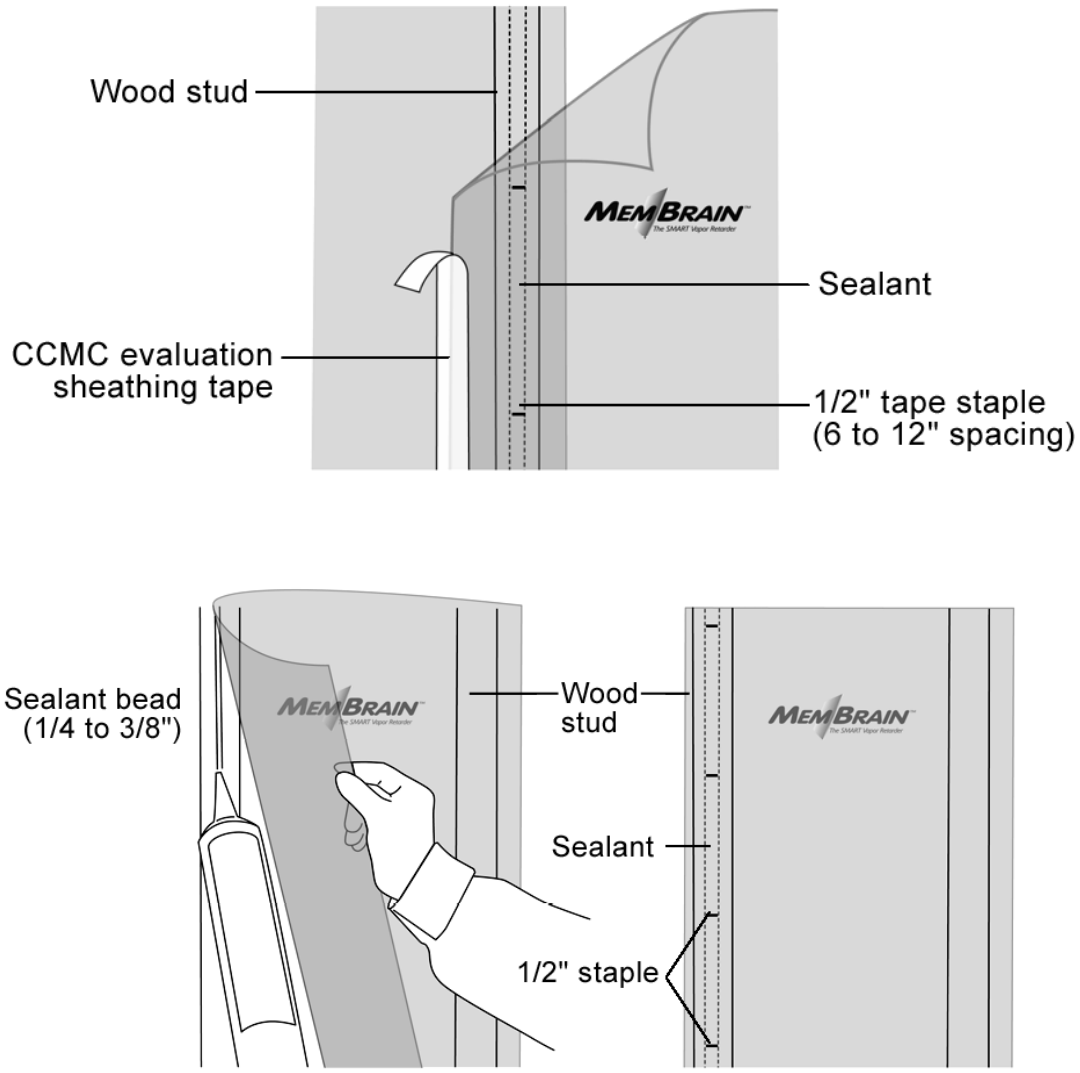

Figure 6. Attachment of "MemBrain™" to studs, with overlapping details.

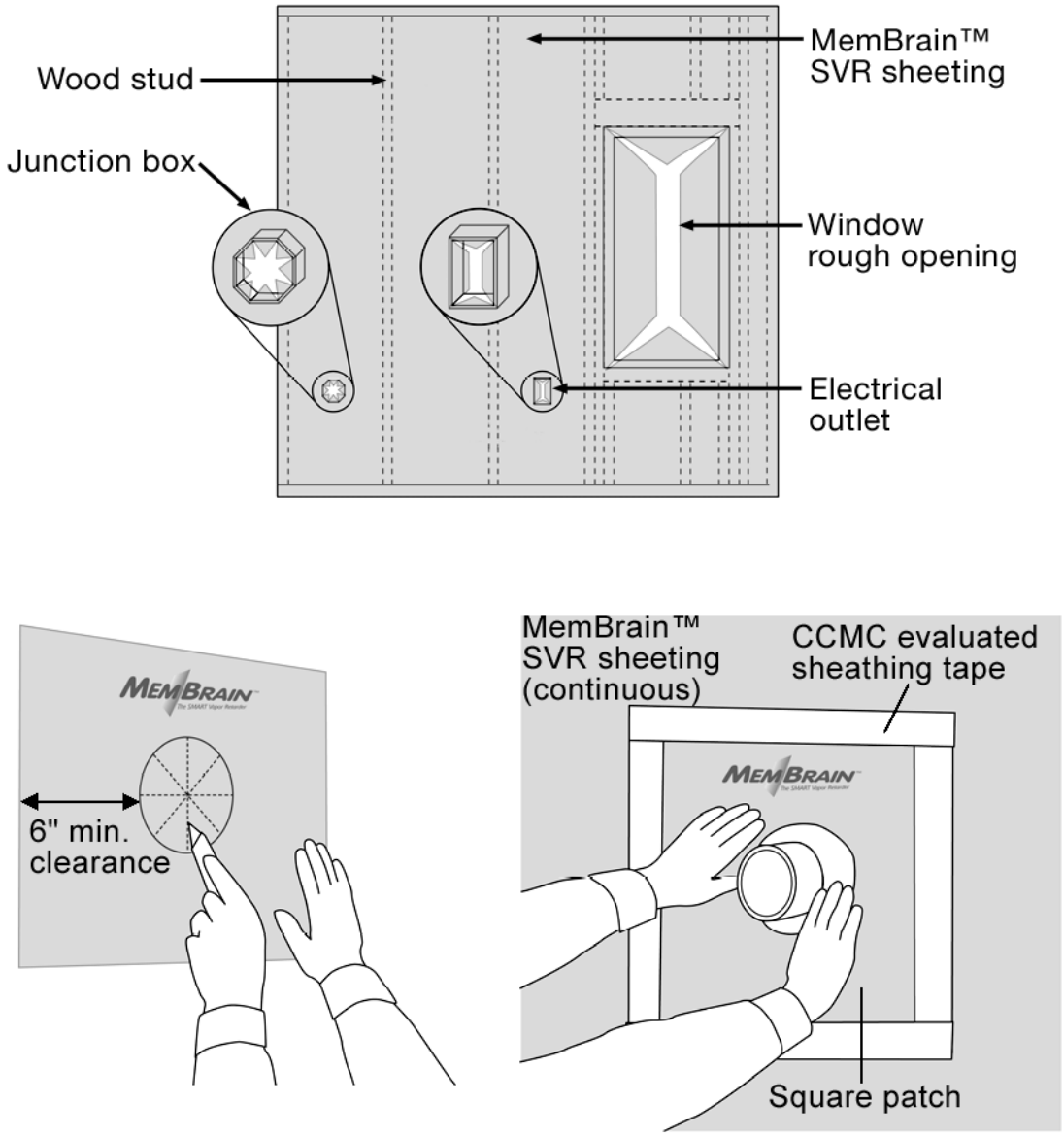

Figure 7. "MemBrain™" details for continuity at junctions of penetrations.

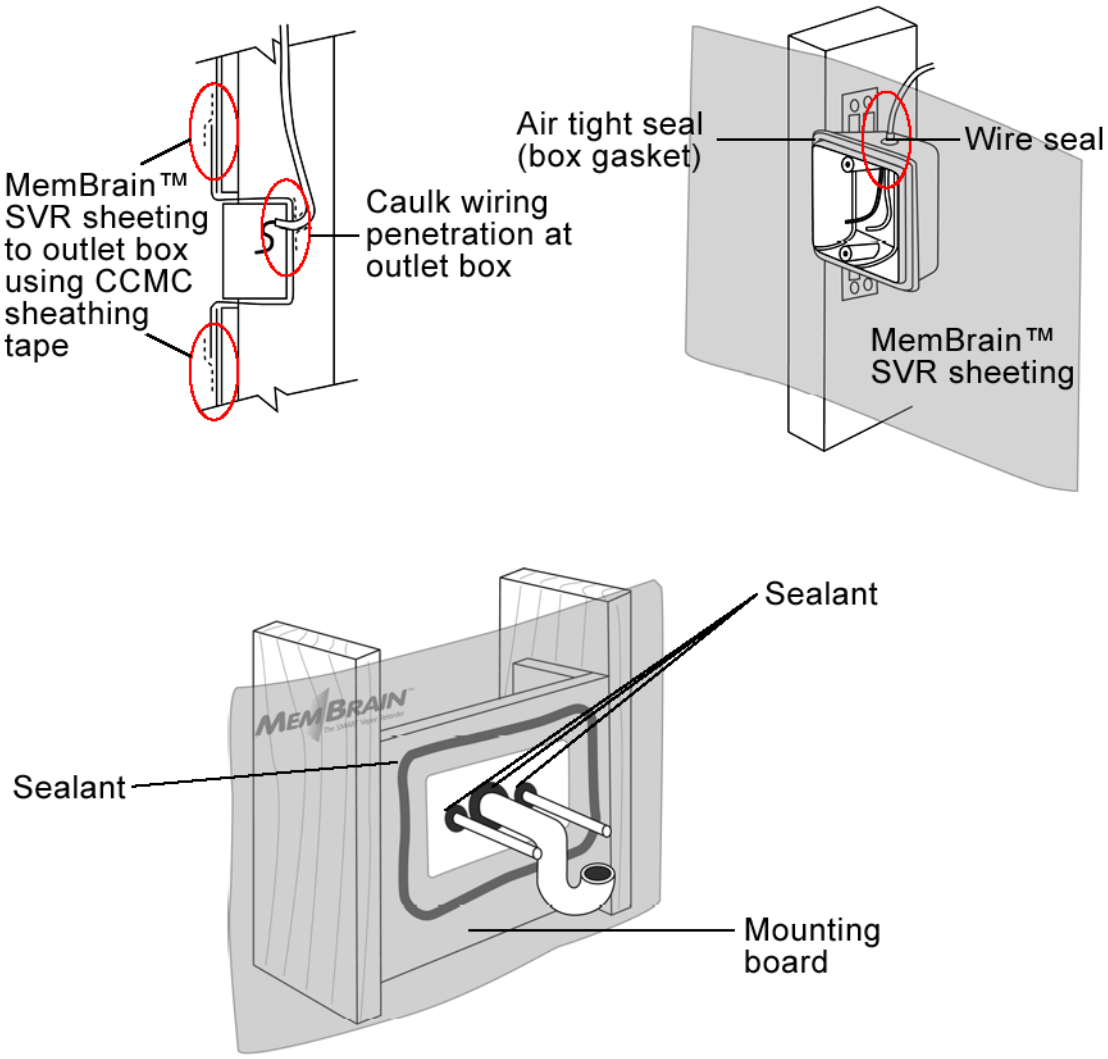

Figure 8. "MemBrain™" details for sealing plumbing and electrical penetrations.

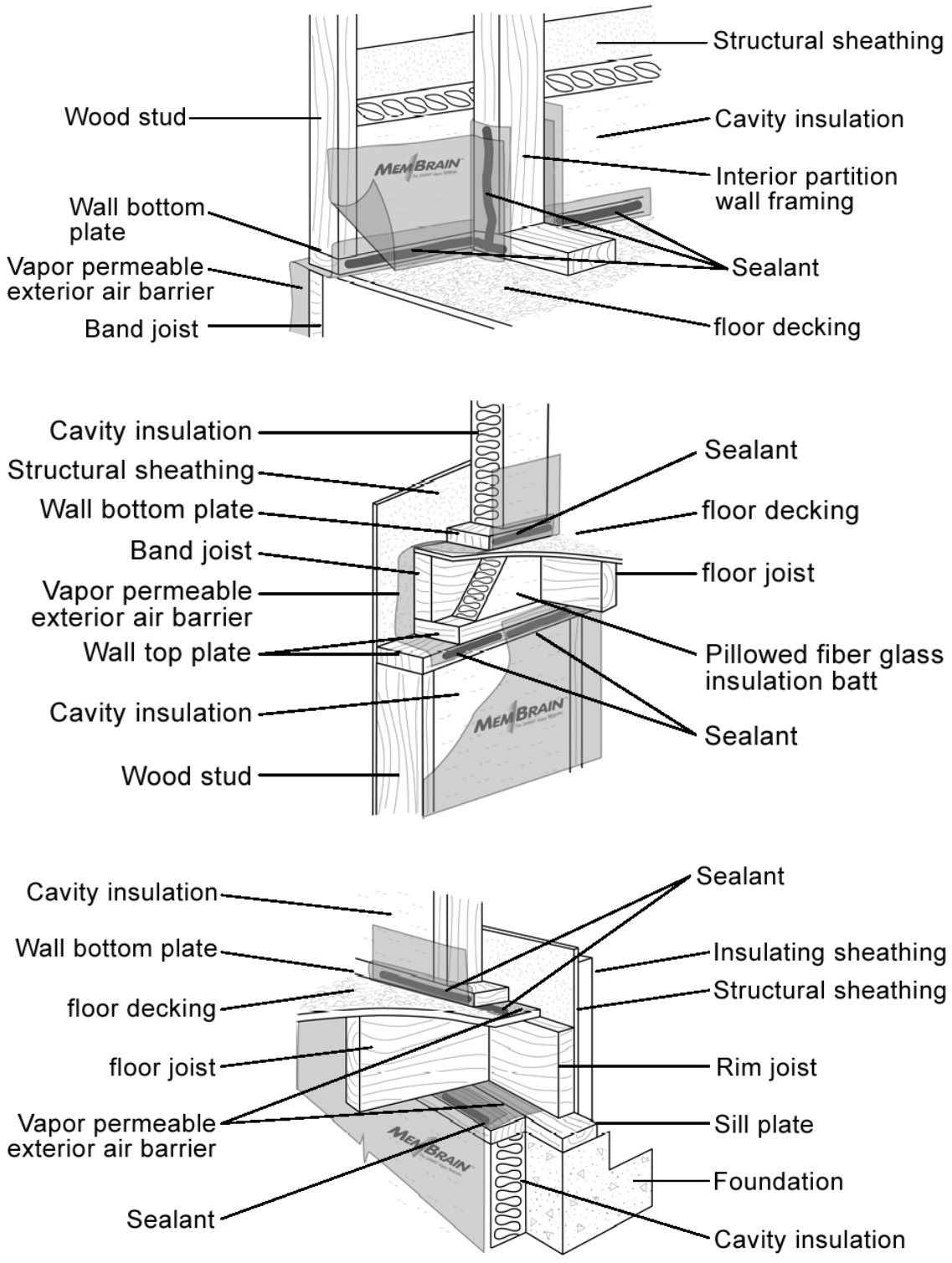

Figure 9. "MemBrain™" details for continuity across floor plate and at intersecting interior walls.

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