Tough Act to Follow

DISCLAIMER
I do not represent any insulation manufacturers
"Give me the luxuries of life and I will willingly do without the necessities."

Frank Lloyd Wright

I am a recovering architect
The Contractor’s Serenity Prayer

God, grant me the serenity to accept the details I cannot change,
The courage to change the details I can,
And the wisdom to know the difference

(and a big fat warranty budget just in case)
INSTRUCTIONS (ASTM B1602-14 AND B2207-14)

1. REMOVE SAMPLES FROM THE COLD STORAGE DEVICE.
2. PLACE THEM IN ORDER ON THE TABLE.
3. NOTE THAT THEY ARE LABELED A-G ON THE SAM.
4. OPEN THE SAMPLES.
5. TASTE IN ALPHABETICAL ORDER.
6. RECORD YOUR SCORES ON THE WHITE BOARD.
7. TALLY SCORES TO FIND THE TOP TWO SAMPLES.
8. REFER TO THE KEY FOR THE MANUFACTURER AND PRODUCT.
9. REPORT TESTING RESULTS IMMEDIATELY TO QUALITY CONTROL (MARTY).

INSTRUMENTAL INSTRUCTIONS

1. DO NOT OPEN THE WRAP UNLESS YOU ARE CERTAIN IT IS THE SAMPLE YOU ARE TESTING.
2. DO NOT OPEN THE WRAP ON THE NEXT SAMPLE WITHOUT THE SAMPLES BEING TESTED.
4. IF YOU DON’T LIKE THE WAY IT LOOKS, YOU DON’T FEEL IT, OR IF IT IS PRETTY, SPIT THE LEFTOVER BEERS AND TAKE THEM HOME. DON’T BE PROUD OF BEING A LEFTY/WRIGHT.
5. SLUMP THE CUP OUT OF THE COOLER IN THE GROUNDS FLOOR GARAGE AND LEAVE THE COOLER IN THE ANKLE. THE KEY IS ON THE DOOR’S HANDLE.
6. IF YOU THINK YOU’RE EXPERIMENTING, THIS BEER IS TAKING A LITTLE OXYGEN TO TEMPER THE CUP AND TO STRETCH OUT THE WAIST. WE DON’T WANT TO LOOK LIKE PUSSIES AT BROWN’S CAMP. THERE IS ONLY 1% THAT ONE MEMBER OF OUR TEAM WILL NOT HAVE THIS COVERED—BEING A LEFTY/WRIGHT, I MEAN. DON’T LET IT BE YOU.
THE GOOD
THE BAD
and
THE UGLY

Trust but Verify
“If you tell the truth you don’t have to remember anything”
BTW
“It doesn’t rain in Sacramento”
Trust but Verify
Nineteenth Annual Building Science Symposium
August 3, 2015

Houston

21 of 143

Note from:
Pre-installation Meeting
NARMS Thorensol Installation

1. Pre-installation:

- Prior to the installation of the Thorensol system, the walls and ceiling of the room will be prepared as follows:
  - Remove all existing finishes, including wallpaper and paint.
  - Clean the surface to ensure a smooth working environment.
  - Protect existing fixtures and surfaces that will not be covered by the Thorensol installation.

2. Installation:

- The installation process will follow these steps:
  - Measure the dimensions of the room to determine the size of the Thorensol panels required.
  - Cut the panels to fit the room dimensions.
  - Install the panels using the appropriate adhesive and fastening system recommended by the manufacturer.
  - Ensure proper alignment and level placement of the panels to achieve a flat, even surface.

3. Post-installation:

- After the installation is complete, the following steps should be taken:
  - Allow the adhesive to cure for the recommended time as specified by the manufacturer.
  - Clean the surface of the panels to remove any excess adhesive or debris.
  - Inspect the installation for any issues, such as air pockets or uneven surfaces.

4. Maintenance:

- Regular maintenance is recommended to keep the Thorensol system in optimal condition:
  - Clean the panels with a damp cloth and mild detergent.
  - Avoid using abrasive cleaners or harsh chemicals.
  - Inspect the panels annually for any signs of wear or damage.

5. Troubleshooting:

- In case of any problems, contact the manufacturer's customer service for assistance.

6. Contact Information:

- For further details or inquiries, please contact the manufacturer's customer service:
  - Phone: (123) 456-7890
  - Email: support@thorensol.com

7. Safety Precautions:

- Prior to the installation, ensure that all necessary safety precautions are taken:
  - Wear protective clothing and goggles.
  - Keep flammable materials and open flames away from the installation area.
  - Use proper ventilation to minimize exposure to fumes.

8. Warranty:

- The manufacturer offers a warranty on the Thorensol system for a period of five years from the date of installation.

9. Liability:

- The manufacturer is not liable for any damages or losses resulting from the use of the Thorensol system.

10. Legal:

- This document is subject to change without notice.

By: [Signatures]

Date: [Date]

[Company Logo]
Consider fastening sill of window into back angle.
Consider flashing below pre-cast per BIA tech note 7, figure 12.
Photos:

Photo #1
Metal “L” angle sill dam requires secure attachment to opening sill
Flash tape applied onto sill dam leg and on opening sill

Photo #2
Standard installation Clip is cut to length and then bent 90°. The clip length will need to be determined per job as it is based on the width of the joint between the sill dam and the window plus the leg height of the sill dam.
How often are these clips placed (what is the spacing)?

Installation: Clip inserted into the fin groove. As previously noted this method is also suited to Series products.

---

Photo #4

The Installation Clip is screw (or rivet) attached to the sill dam leg. Note: This anchorage should only be performed after the jambs of the window are securely attached, otherwise the insertion of the screw will initially tend to push the clip and window to the exterior.

Note: Pre-drilling is recommended prior to insertion of the screw. To prevent the drill bit from puncturing the window frame: insert a wood or vinyl spacer between the clip and the window frame.
Photo #5
The screw is to be of minimum length so that it does not penetrate the window frame.

Photo #6
Hold leg of installation clip 1/8" below top of sill dam leg in order to apply sealant completely over the clip.
Apply continuous backer rod and sealant between the sill dam and the window frame.

This appears to show a sealant joint at the front edge which will prevent drainage of the sill pan.

Mock-up & Report by:
It was at this point that our window installation crew (also our framer) refused to execute the project.

Looks like it’s going to be a long weekend.
“Those tests don’t count”

Physics is different when the manufacturer is present

Cladding wasn’t installed
Luckily, our design team rushed to the rescue

<table>
<thead>
<tr>
<th>In-House Testing:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
</tr>
<tr>
<td><strong>Conducted By</strong></td>
</tr>
<tr>
<td><strong>Third Party Observation</strong></td>
</tr>
<tr>
<td><strong>Testing Standards</strong></td>
</tr>
<tr>
<td><strong>Test Pressures</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td># <strong>Acceptance Standard</strong></td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
</tr>
</tbody>
</table>
Luckily, our design team rushed to the rescue

<table>
<thead>
<tr>
<th>In-House Testing:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
</tr>
<tr>
<td>Note that tests will be conducted in a test chamber constructed by personnel, with window perimeters sealed to window opening using a combination of self-adhering flashing membrane and duct tape.</td>
</tr>
<tr>
<td><strong>Conducted By</strong></td>
</tr>
<tr>
<td>Employees with knowledge of AAMA testing standards and expertise in conducting manufacturer testing of window units</td>
</tr>
<tr>
<td><strong>Third Party Observation</strong></td>
</tr>
<tr>
<td>Full time on-site observation by staff member from other Construction</td>
</tr>
<tr>
<td><strong>Testing Standards</strong></td>
</tr>
<tr>
<td>Testing procedures to comply with AAMA 502 / ASTM E 1105.</td>
</tr>
<tr>
<td><strong>Test Pressures</strong></td>
</tr>
<tr>
<td>5.0 lbs/cu. in. for single framed windows</td>
</tr>
<tr>
<td>4.5 lbs/cu. in. for mullion framed windows</td>
</tr>
<tr>
<td><strong>Acceptance Standard</strong></td>
</tr>
<tr>
<td>Per AAMA 502 and Specification Section 085313, Paragraph 1.7.8.1.b., with additional agreement that no water is to pass to the visible side of any portion of the test specimen and/or test assembly. No condensation will be made as to whether the path may be through the window unit, the perimeter seal, or the framed wall test panel. Per above, AAMA 502</td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
</tr>
<tr>
<td>Minimum of 75 units</td>
</tr>
</tbody>
</table>
Marty,

After review of our phone conversations, your proposal, and review with the Team, as a goodwill gesture we have a proposed resolution that we believe should work for all involved:

- [ ] will remediate 100% of the units. Remediation for this specific job includes filling portions of the frame with foam, application of sealant at mitered corners, and removal of tape seal at sill and head 3/8" from edges of frame.
- [ ] will test as many units as needed to provide a confidence factor that the above-mentioned remediation is performing to the project specifications. We feel confident that with the remediation the windows will perform to the project specifications.
- [ ] Walsh Construction Company, architects and/or can visit the Facility near Portland Oregon, where the testing of the remediated windows is being performed, to observe the testing being performed. All agree that there will be no compensation by to a third-party for third-party witnessing of the test.
30% of ‘remediated” windows were rejected
Total numbers of windows tested
294

Number of windows that failed
32
(10.8%)

Number of windows that failed again
9
(28.1%)

Total number of installation failures

Number of windows that failed
32
(10.8%)

1
(.3%)

Number of windows that failed again
9
(28.1%)
LABORATORY CERTIFICATE

June 26, 2015

LABORATORY NUMBER: 6004.8907

CUSTOMER AUTHORIZATION: Letter dated June 17, 2015, for Project 123456

SUBMITTED: June 14, 2015

TO: Walpole Construction Company

Sub: Testing Results

1. Sample No. 1
2. Sample No. 2

SUBJECT:

Two samples of test were submitted for comparative analysis.

SAMPLES SUBMITTED:

1. Isolated, White, 0.5 lb. on backing, Sample No. 1
2. Isolated, White, 0.33 lb. on backing, Sample No. 2

ANALYSIS:

The samples were examined for tear time and tensile strength by analysis of 12 and 24 hours of tear time using ASTM Standard D1928 and Kent Specimen (KSI), extensometer, and test methods. All tests were conducted at 23°C and 50% relative humidity. The results were calculated using ASTM D1928-01 and ASTM D1688-01.

RESULT OF ANALYSIS:

Tear Time:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Tear Time, Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No. 1</td>
<td>20</td>
</tr>
<tr>
<td>Sample No. 2</td>
<td>24</td>
</tr>
</tbody>
</table>

Parameter Barriers, Sheet A, 160 hours:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

Figure 3: The FTR Spectra Obtained on the Acetone/Toluene Soluble Portion of the Tensile and Storage Barrier Samples after 8 Hours Cure Time.
Figure 3: The FTIR Spectrum of the Substrate Residue for Acetone/Hexane Soluble Portion of Barrier Membrane after 48 Hours of Cure Time Meets Weather-Oxidative Resistance.

**FTIR:**

**Pyridine:**

The FTIR spectrum obtained on the pyridine-potential products of the tube solution after 48 hours of cure time revealed the presence of polyethylene trimethylene (peptides) and polyethylene glycol.

The FTIR spectra presented in Figure 4.

---

Figure 4: The FTIR Spectra Obtained on the Acetone/Hexane Soluble Portion of the Tube and Barrier Membrane Samples after 48 Hours Cure Time.
Two sides to every story
University of Idaho Kibbie Dome
• Life Safety Upgrade to an Essential Facility
  • Fire safety
  • Egress
  • Smoke Evacuation
• Opsis Architects
Multi-Purpose Facility

More than just football

Special Events
- Jazz Festival
- Commencement
- Home & Garden Show
- Concerts
- RV Show
- Basketball
- General education courses
- Intramurals
- Student recreation
Heating climate 8 months of the year— with lots of wind
Code Compliance Audit Results

- Building Design
  Wood Construction does not meet code for assembly occupancy
- Egress
  Occupant Load – 16,000
  Aisles 24% required width
  Doors 58% of required width
- Fire Detection / Suppression
  No Sprinklers in Concealed Truss Space
- Smoke Control
  None Existing
- Structural
  Sound Structure

Wood Construction

- Concealed Space in Truss
- Occupancy / Building Type
- Wood End Walls
new exit towers from below grade field
new stairs to field

Egress Issues

exit doors to nowhere
<table>
<thead>
<tr>
<th>Tenability Criteria</th>
<th>Metric Units</th>
<th>English Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility</td>
<td>10 meters</td>
<td>33 feet</td>
</tr>
<tr>
<td>Temperature</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Toxicity (CO)</td>
<td>1,000 ppm</td>
<td>1,000 ppm</td>
</tr>
</tbody>
</table>

Critical Temp Isosurface

No smoke control

Daylighting Study
Improved Smoke Evacuation
Improved Daylighting
Improved Thermal Control
Improved Air Control
Improved Smoke Evacuation
Improved Daylighting
Improved Thermal Control
Improved Air Control
ASUI Kibbie Activity Center

2008-2011 Electrical Consumption

-48%
ASUI-Kibbie Activity Center

Natural Gas Consumption 2008 - 2011

-25%

I've got to admit it's getting better. It's a little better all the time.

(Paul McCartney)
HATFIELD PRESERVATION PROJECT

Structural and Energy Upgrades
to an Historic Structure

WHY THE CONCERN?

NEGATIVE CASH FLOW

OPERATING EXPENSES

INCOME

POSITIVE CASH FLOW

TIME
MARK O. HATFIELD BUILDING

**History**

- **Widening of Burnside in 1930**
- **Facade Repair in 2010**

- **Built in 1910**
- **Hatfield converted to CCC housing in 1994**
- **Phase 01 of Passive House rehab**

---

MARK O. HATFIELD BUILDING

**Basic Building Design**

- Siting
- Solar and Winds
- Geometry
MARK O. HATFIELD BUILDING
Basic Building Design

- Structural Frame
- Windows
- Heating System

MARK O. HATFIELD BUILDING
Envelope

- Window to Wall Ratio
- Thermal Bridging
- Frame
- Windows
MARK O. HATFIELD BUILDING
Mechanical

• Inefficient Boiler

MARK O. HATFIELD BUILDING
Mechanical

• Inefficient Radiators
PASSIVE HOUSE FEASIBILITY
A Phased Approach to Deep Energy Retrofits

BIG PICTURE PLANNING
The Ideal Package
### ASSEMBLY OPTIONS

<table>
<thead>
<tr>
<th></th>
<th>Existing Building</th>
<th>Good Rehab</th>
<th>Better Rehab</th>
<th>Best Rehab Passive House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement Slab</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Insulation</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>First Floor Insulation</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Wall Insulation</td>
<td>none</td>
<td>none</td>
<td>2&quot; EPS Exterior Insulation</td>
<td>6&quot; EPS Exterior Insulation</td>
</tr>
<tr>
<td>Roof Insulation</td>
<td>Existing 4&quot; Polyiso Board</td>
<td>Existing 4&quot; Polyiso Board w/limited repair</td>
<td>Existing 4&quot; Polyiso Board w/limited repair</td>
<td>Existing 4&quot; Polyiso Board w/limited repair</td>
</tr>
<tr>
<td>Window Frame</td>
<td>Aluminum (not thermally broken)</td>
<td>Fiberglass (Cascadia 300 tilt turn)</td>
<td>Fiberglass (Cascadia 300 tilt turn)</td>
<td>Fiberglass/ Vinyl (Rehau Geneo Euroline 4700)</td>
</tr>
<tr>
<td>Frame U-Value</td>
<td>unknown</td>
<td>0.289</td>
<td>0.289</td>
<td>0.14</td>
</tr>
<tr>
<td>Window Glazing</td>
<td>Single Pane</td>
<td>2-pane/Cardinal LoE 366 Argon</td>
<td>3-pane/Cardinal LoE 366/180 Argon</td>
<td>3-pane Rehau Geneo P+2</td>
</tr>
<tr>
<td>U Value IGU</td>
<td>1.02</td>
<td>0.20</td>
<td>0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Air tightness (ACH at 50 pa)</td>
<td>10</td>
<td>5.00</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Air tightness (cfm/ sf, 75a)</td>
<td></td>
<td></td>
<td>0.16</td>
<td>0.16</td>
</tr>
</tbody>
</table>

### ENVELOPE PERFORMANCE STUDY

**Annual Heating EUI (Source: Green Hammer)**

![Graph showing reduction in Heating EUI from existing to best rehab]

Reduction from Existing

- Existing: 38%
- Good: 89%
- Better: 96%
COMPLETED PROJECT SCOPE

Phase 01

- Single pane windows replaced with Cascadia triple pane windows
- Windows and flashing designed to anticipate EIFS at a later date
- Mechanical ventilation designed to anticipate HRV at a later date
- Heating disconnected from oversized boiler and switched to unit electric heaters with connection to window watchers
- Installed new high efficiency DHW Heaters
- Concrete repair and air sealing

Challenges
- Site Access
- Safety
- Contract Structure
- Size of Windows
- Unit Access/Timing
Challenges

- Site Access
- Safety
- Contract Structure
- Size of Windows
- Unit Access/Timing
Challenges

- Site Access
- Safety
- Contract Structure
- Size of Windows
- Unit Access/Timing
Challenges
• Site Access
• Safety
• Contract Structure
• Size of Windows
• Unit Access/Timing
### Air Leakage Testing of Mockup

<table>
<thead>
<tr>
<th>Test Date:</th>
<th>Formal Test Pressure:</th>
<th>Cycle #</th>
<th>Start Time</th>
<th>End Time</th>
<th># Ingress</th>
<th># Leaks</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/5/11</td>
<td>0.75 in Hg</td>
<td>1</td>
<td>11:42</td>
<td>11:57</td>
<td>0</td>
<td>0</td>
<td>Pass</td>
</tr>
</tbody>
</table>

#### Specimen ID:
- 1 Equilateral Py: 464 Py.
- Level: 2 Equivalent "WC": 1.61" WC.
- Unit #: Common Velocity Pressure: 62.5 mph.
- Elevation: Rust. (U) Pressure: 10 Negative.

**Documented instances of fault listings:** No.

**FINAL TEST RESULTS:**
- Window: FULL PASS.
- Installation: FULL PASS.

---

**TEST PHOTOS:**

1. Audience members observe specimen performance from.
2. View of exterior of test area where scaffolding had been.

---

**Air Density**

<table>
<thead>
<tr>
<th>lt/ft³</th>
<th>Reference Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.078139286</td>
<td>0.075</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>total flow Qt (cfm)</th>
<th>actual leakage Qs (cfm)</th>
<th>Opbr crack length L (ft)</th>
<th>Opbr rate of leak qL (cfm - ft)</th>
<th>Unit area A (ft²)</th>
<th>Unit area rate of leak qA (cfm - ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>1.041857143</td>
<td></td>
<td></td>
<td></td>
<td>0.008981527</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#DIV/0!</th>
<th>116</th>
</tr>
</thead>
</table>
PERFORMANCE
Total Energy Use (BTU’s per Sq.Ft.)

47% total energy reduction
PERFORMANCE
Gas Use (BTU’s per Sq.Ft.)

PERFORMANCE
Electric Use (BTU’s per Sq.Ft.)
PERFORMANCE
July 2011
$ Cost Breakdown

<table>
<thead>
<tr>
<th>Utility</th>
<th>Amount spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>$1,890.38</td>
</tr>
<tr>
<td>Electric</td>
<td>$3,900.73</td>
</tr>
<tr>
<td>Gas</td>
<td>$1,170.25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$6,961.36</strong></td>
</tr>
</tbody>
</table>

PERFORMANCE
July 2013
$ Cost Breakdown

<table>
<thead>
<tr>
<th>Utility</th>
<th>Amount spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>$1,826.21</td>
</tr>
<tr>
<td>Electric</td>
<td>$3,130.69</td>
</tr>
<tr>
<td>Gas</td>
<td>$585.90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$5,542.80</strong></td>
</tr>
</tbody>
</table>

Houston
**PERFORMANCE**

**January 2012**

$ Cost Breakdown

<table>
<thead>
<tr>
<th>Utility</th>
<th>Amount spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>$2,259.59</td>
</tr>
<tr>
<td>Electric</td>
<td>$5,090.00</td>
</tr>
<tr>
<td>Gas</td>
<td>$1,391.31</td>
</tr>
<tr>
<td>Total</td>
<td>$9,240.90</td>
</tr>
</tbody>
</table>

**PERFORMANCE**

**January 2013**

$ Cost Breakdown

<table>
<thead>
<tr>
<th>Utility</th>
<th>Amount spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>$2,414.28</td>
</tr>
<tr>
<td>Electric</td>
<td>$6,193.49</td>
</tr>
<tr>
<td>Gas</td>
<td>$632.54</td>
</tr>
<tr>
<td>Total</td>
<td>$9,300.31</td>
</tr>
</tbody>
</table>
PERFORMANCE
Dollars Per Occupant Per Year
Before Rehab: $770
After Rehab: $530
Savings: $240

Dollars Per Year (Whole Building)
Before Rehab: $81,620
After Rehab: $56,224
Savings: $25,396

Percent Savings in Dollars Per Year: 31%

Sustained energy reduction of 45%
“It is not enough to do your best; you must know what to do, and then do your best”
- W. Edwards Deming

REACH Community Development

• Mission
  Provide quality, affordable housing for individuals, families and communities to thrive

• Board of Directors
  REACH is overseen by a volunteer board

• Overview
  - Established in 1982
  - Private, nonprofit
  - 1,852 units in metro area
  - 115 staff
The vision and commitment came from REACH Community Development. REACH has a goal of providing not just affordable housing, but also “affordable living” opportunities—which means reducing the total cost to residents of rent, utilities, transportation and food. After seeing Passive House projects in Europe, REACH’s former executive director got excited about bringing the idea to the U.S., and REACH included it as a goal in its current five-year strategic plan.

Orchards at Orenco
Passive House Construction
Design Stage Interface
REACH/Ankrom/WCC
THE ORCHARDS AT ORENO STATION PHASE 1

07.54.13

DD SET

THERMOPLASTIC MEMBRANE ROOFING (TPO)

SEPT 2013

PAGE 6 of 11


2.02 PERFORMANCE REQUIREMENTS

A. Installed roofing membrane and base flashings to remain watertight, resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. UL Class A for Roofing System.

C. Wind resistance to meet:
   1. Factory Mutual (FM) Class 1-90. Membrane
   2. Wind Design Criteria: 80 mph, Exposure B.

2.03 MATERIALS

A. Membrane: Scrim-reinforced, thermoplastic polyolefin (TPO)-based sheet per ASTM D 6878 and bearing UL label on packaging.
   1. Sheet Width: 120 inches minimum.
   2. Thickness: 0.060 inch, nominal, when measured in accordance with ASTM D 751.
      a. Minimum weather surface thickness: 15 mils.
   4. Breaking Strength: 366 lbf, when tested in accordance with ASTM D 751, Grab Method.
   6. Tear strength (ASTM D 751, Procedure B), 8 x 8 inch sample: 86 lbf

---

PART 2 PRODUCTS

2.01 MATERIALS

A. As noted above in Related Requirements, Materials specified make up the air barrier system of the building to be inspected and tested.

2.02 PERFORMANCE REQUIREMENTS

A. Materials:
   1. Air barrier system materials in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft2 under pressure differential of 0.3 in. water (1.57 psf) (0.0002 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E2178.

B. Assemblies of Materials and Components:
   1. Air permeance not to exceed 0.04 cfm/ft2 under a pressure differential of 0.3 in. water (1.57 psf) (0.002L/s.m2 @ 75 Pa) when tested in accordance with ASTM E1677 or E783.

C. Air tightness Goal of Entire Building:
   1. Air leakage of the entire building shall not exceed 0.40 cfm/sf under a pressure differential of 0.3 in. water (1.57 psf)(0.02L/sm2 @ 75 Pa) when tested according to
Design Stage Interface
REACH/Ankrom/WCC
Construction Documents
Sealant as shown doesn't make much sense. Please consider extending sheathing to bottom of plate so that fewer transitions in SAM are required. SAM is not in contact with sheathing. How is this detail air tight?

Sealant as shown doesn't make much sense. Please consider extending sheathing to bottom of plate so that fewer transitions in SAM are required. SAM is not in contact with sheathing. How is this detail air tight?

5 RADON VENT AT SLAB

Sealant as shown doesn't make much sense. Please consider extending sheathing to bottom of plate so that fewer transitions in SAM are required. SAM is not in contact with sheathing. How is this detail air tight?
Construction Stage Interface
REACH/Ankrom/WCC
Building Envelope Coordination
Nineteenth Annual Building Science Symposium
August 3, 2015

1. General
   - Introduction / Handouts

2. Schedule
   - Review overall construction schedule
   - Available scope of work / start dates for all trades
   - Review general sequencing plan
   - Update scope of work / construction plan

3. Safety Procedures
   - Review safety processes / requirements for each trade
   - Review preconstruction approvals
   - Review preconstruction submittals

4. RFQ / RFx Procedures
   - Review RFQ / RFx requirements
   - Evaluate process for receiving design drawings / changes and specifically addressed in drawings

5. Framing and DC-Build B 9:00AM-10:00AM
   - Work order
   - Product specifications
   - Product requirements
   - Installation requirements
   - QA/QC requirements

6. Roofing
   - Product specifications
   - Product requirements
   - Installation requirements
   - QA/QC requirements

- QA/QC requirements
- Safety requirements
- Owner plans
- Submittals
- QA/QC requirements
- Safety requirements
- Owner plans
- Submittals
- QA/QC requirements
- Safety requirements
- Owner plans
- Submittals
- QA/QC requirements
- Safety requirements
- Owner plans
- Submittals
Construction Stage Interface
REACH/Ankrom/WCC
Mock Up
Construction Process
WCC/Subs
Not a quantitative test
Purely qualitative
5 infrared cameras
2 smoke pencils
1 Wizard Stick
9 Curious Contractors
Mike and the Open Door
<table>
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<th></th>
<th>CFM @ 50</th>
<th>Actual CFM</th>
<th>ACH50</th>
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