UPDATE ON THE AIR BARRIER ASSOCIATION OF AMERICA

Presented by Laverne Dalgleish
Air Barrier Association of America

- Technical Trade Association
  - Members (manufacturers, contractors, design professionals, suppliers, etc)
    - Board of Directors
      - Education & Outreach Committee
      - Technical Committee
      - Housewrap Committee
      - Flashing and Caulking Committee
      - Existing Building Committee
Air Barriers -102

Based ISO 9001 Model for Quality Assurance

- Research & Development
- Standards & Specifications
- Manufacturer Product Listing
- Accreditation of Contractors
- Installer Training & Certification
- Documentation
- Field Audits (Inspections)
- Database Tracking
- Warranty
- Appeal Process

ISO 9001:2015 Model for Quality Assurance
Air Barrier Association of America

- Services
  - Education
  - Technical
    - Development of Standards ABAA to ASTM
    - Publication of ABAA Master Specifications
    - Listing of Manufacturers Products
    - Accreditation of Contractors
    - Training – Installers and Contractors
    - Certification of Installers
    - Project Audits
    - Technical Support
Air Barrier Association of America

- **Research**
  - ABAA/DOE/ORNL/SU Air Barrier Research Project
  - ABAA/NRC Wall Drainage Project

- **Standards**
  - ASTM E 06
  - Army Corp of Engineers – Whole Building Testing
    - Whole building testing
    - Blower door personnel certification
    - Air barrier details
    - States and Cities following
Air Barrier Association of America

- Air Barrier Materials & Assemblies
  - Listing service
- Specifications
  - 2010 Versions
  - New specs – boardstock, panels
- Existing Buildings
  - Specifications, training, audits, etc
Air Barrier Association of America

- **Education & Outreach**
  - Design professionals education
  - General contractor education
  - Buildings XI
  - Trade contractor education
Air Barrier Association of America

- Codes
  - ASHRAE 90.1
  - IECC
  - State Codes
  - ASHRAE Standard 189
What’s to research?

What works and what does not work
NIST study establishes no relationship between any of these points.
The Project consists of 8 phases

1. Project administration (reporting, project administration)
2. Material property characterization
3. Sub-system and wall characterization
4. Laboratory wall testing
5. Advanced moisture engineering modeling
6. Exterior field testing of air barrier systems
7. Wall optimization
8. Information technology transfer, publications, etc.
Three critical competencies

Lab  Modeling  Field
The Project

Sub-system and wall characterization

All participants will be included to define the assembly, the sub-components of the assembly and issues that impact the assembly.

- For example: Do a lot of staples or a few staples have a significant impact on the air permeance of an assembly? How critical is the initial bond to the substrate for self adhered membranes?

- All participants will have the opportunity to pose their questions and challenges.
Air Barrier Association of America

- **The Project**
  - **Material property characterization**
    - Each of the participants will have the opportunity to submit materials to the project
    - We have self adhered membranes, fluid applied membranes and mechanically fastened membranes
    - All materials shall meet the requirements to be an air barrier material $<0.02 \text{ L/(s·m}^2\text{)} @ 75\text{Pa} \Delta P$
    - Materials may be able to be grouped after their characterization
The Project

Material property characterization

- Material properties that deal with heat, air and moisture (liquid and vapor) will be included
Laboratory Analysis
System & Sub-System Characterization
Thermal + Water + Air Leakage

A Technical Leap - Air Barrier Integration to Building Enclosures

Air Flow Characterization
10 Walls
6 - Subsystems

Deliverables
1) Air Leakage through Wall system
2) Flow at joints/interfaces
3) Air flow distribution

Water Retention & Drainage
10 Walls

1) Water WRB Retention
2) Drainage Water Performance
3) Drainage Drying + Solar
4) Wall Wetting and Drying

Thermal Testing
4 Walls

"Whole Wall" R-Value Comparison
A Technical Leap - Air Barrier Integration to Building Enclosures

Laboratory Analysis
System & Sub-System Characterization
Thermal + Water + Air Leakage

Air Flow Characterization
10 Walls
6 - Subsystems

Responsibility
University with ORNL Coordination

Water Retention & Drainage
10 Walls

ORNL + University

Thermal Testing
4 Walls

ORNL

Responsibility of
Construction of
Walls for Lab testing
ABAA

ASTM E1186 Air Leakage Testing

ASTM E331 Water Penetration Testing
Why a field performance test facility?

- Laboratory provides characterization but field performance is what counts
Air Barrier Association of America

- Field performance test facility
Air Barrier Association of America

- Field performance test facility
Define 18 Building Envelope Walls for Air Barrier & Energy Efficiency Analysis

Laboratory Analysis
System & Sub-System Characterization
Thermal + Water + Air Leakage

Develop Field Data for 18 Wall Systems

Validate MOISTURE-EXPERT Model

HYGROTHERMAL MODELING
System Optimization Parametric Investigations

Development of Air Barrier Guidelines for Energy Efficient Wall Systems
Define 18 Building Envelope Walls for Air Barrier & Energy Efficiency Analysis

Executive Committee (1-ABAA, 1-ORNL)

ABAA

ABAA Industry Members
Steering Committee

X1, X2, ..., Xn

DOE/ORNLD

Scientific Members
Steering Committee

DOE, SU, ..., BA

X1...Xn = Industry Members

DOE = Department of Energy
SU = Syracuse University
BA = Building America
A Technical Leap - Air Barrier Integration to Building Enclosures

Develop Field Data for 18 Wall Systems

Committee for Test Building Construction (DOE, ABAA, INDUSTRY, University) Responsibility: Mr. Dalgleish (ABAA)

Site Location & Preparation

Architectural Design/ Flexible & Interchangeable Wall

Site Legalities & 3 year ABAA use with option for 3 additional years then (60 % SU and 40 % ORNL)

Contractor Selection & Building/Inspection

…………..Continued
A Technical Leap - Air Barrier Integration to Building Enclosures

Develop Field Data for 18 Wall Systems

Committee for Test Building Construction (DOE, ABAA, INDUSTRY, University)  Responsibility: Mr. Dalgleish (ABAA)

Selection of Walls

Construction of Walls
1st set year 1
2nd set year 2

Instrumentation & Data Acquisition

Monitoring and Reporting
Wall Sensors
- Temperature sensors
- RH sensors
- Tracer Gas sensor
- Moisture Content sensors
- Pressure Sensors
- Vertical Rain Gauges
- Solar

Weather Station
- Temperature, RH
- Solar Radiation
- Rain, Solar
- Pressures

### Instrumentation & Data Acquisition

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Repeatability</th>
<th>Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenwall Uni-curve 10K ohm thermistor</td>
<td>±0.2%</td>
<td>-</td>
<td>±0.2%</td>
<td>2.5Vdc</td>
</tr>
<tr>
<td>Honeywell Hy-Cal Humidity Sensor H11H-3610 Series</td>
<td>±2%</td>
<td>-</td>
<td>±0.5%</td>
<td>5Vdc</td>
</tr>
<tr>
<td>Wood moisture content sensors</td>
<td>±2% within 8-30% MC</td>
<td>-</td>
<td>±2%</td>
<td>12Vdc</td>
</tr>
<tr>
<td>Heat Flux Transducer (Concept Engineering Model F-002-4)</td>
<td>-</td>
<td>(1.8·Btu/ft²·Hr)/Mv</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Outdoor RH (Vaisala CS500)</td>
<td>±3%</td>
<td>-</td>
<td>-</td>
<td>12Vdc</td>
</tr>
<tr>
<td>Wind Speed (R. M. Young Model 05305 Wind Monitor)</td>
<td>±0.4%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wind Direction (R. M. Young Model 05305 Wind Monitor)</td>
<td>±3°</td>
<td>-</td>
<td>-</td>
<td>12Vdc</td>
</tr>
<tr>
<td>Rainfall (Texas Electronics Model TE525)</td>
<td>±1%/1”/hr</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Solar pyranometer, vertical (LI-Cor LI200X)</td>
<td>±3%</td>
<td>0.2·kW·m⁻²·mV⁻¹</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Solar pyranometer, horizontal (Kipp &amp; Zonen SP-Lite)</td>
<td>±3%</td>
<td>10µV·W⁻¹·m⁻²</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Campbell Sci CR10X w/32 Channel multiplexer</td>
<td>±0.1% of FSR</td>
<td>-</td>
<td>-</td>
<td>12Vdc</td>
</tr>
</tbody>
</table>
THANK YOU
Sprayed Polyurethane Foam in the Canadian Market

.........in 20 minutes or less

Ryan Dalgleish
Building Professionals
The Canadian Market

- Membership of Association
- Foam Growth
- Standards and Building Codes Work
- Technical Application Issues and Research
- Education Initiatives
- Marketing Initiatives
- Quality Assurance / Consumer Confidence
- SPFA / CUFCA Partnership Opportunities
Membership Growth

- 400 + members in 2010
- Membership has doubled since 2004
- 95% contractors
Foam Growth

- 2006 – 2007: 15 %
- 2007 – 2008: 19%
- 2008 – 2009: 16 %
- 2009 – 2010: ?? (7%)
- Since 2000, it has almost tripled
Standards and Building Codes

CAN/ULC S705.1-01
Material Standard –
Medium density - closed cell

CAN/ULC S712.1-09 –
Material Standard
Light density - open-cell
<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Requirements</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Permeance (Mandatory material only testing)</td>
<td>L/s @ 75 Pa</td>
<td>.02</td>
<td>CCMC Technical Guide for Air Barrier Materials</td>
</tr>
<tr>
<td>Air Permeance (Optional system testing)</td>
<td>L/s @ 75 Pa</td>
<td>.05</td>
<td>CCMC Technical Guide for Air Barrier Systems</td>
</tr>
<tr>
<td>Apparent Core Density</td>
<td>kg/m³</td>
<td>28</td>
<td>ASTM D 1622</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>kPa</td>
<td>170</td>
<td>ASTM D 1621</td>
</tr>
<tr>
<td>Dimensional Stability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume Change at :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-20 C</td>
<td>%</td>
<td>-</td>
<td>-1</td>
</tr>
<tr>
<td>80 C</td>
<td>%</td>
<td>-1</td>
<td>+8</td>
</tr>
<tr>
<td>70 C, 97%RH</td>
<td>%</td>
<td>-</td>
<td>+14</td>
</tr>
<tr>
<td>Surface Burning Characteristics Flame Spread</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Cell Content, Volume</td>
<td>%</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Initial Thermal Resistance for a 50 mm specimen after 3 d at 23 2 C</td>
<td>m²·C/W</td>
<td></td>
<td>Declared</td>
</tr>
<tr>
<td>Type 1</td>
<td>m²·C/W</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>m²·C/W</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Long Term Thermal Resistance (For a 50 mm thick specimen)</td>
<td>m²·C/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>kPa</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Volatile Organic Emissions</td>
<td>Pass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Absorption by Volume</td>
<td>%</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Water Vapour Permeance for a 50 mm thick specimen</td>
<td>ng/(Pa·s·m²)</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## CAN/ULC S712.01 Material Standard
### Light Density - Open Cell

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Requirements</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Property</strong></td>
<td><strong>Unit</strong></td>
<td><strong>Min.</strong></td>
<td><strong>Max.</strong></td>
</tr>
<tr>
<td>Air permeance at 100 mm</td>
<td>L/(s·m²) @ 75 Pa pressure difference</td>
<td>-</td>
<td>Declare</td>
</tr>
<tr>
<td>Apparent core density</td>
<td>kg/m³</td>
<td>6.8</td>
<td>12</td>
</tr>
<tr>
<td>Dimensional stability volume change at:</td>
<td>%</td>
<td>-</td>
<td>Shrinkage</td>
</tr>
<tr>
<td>-20 C</td>
<td></td>
<td>-</td>
<td>-1</td>
</tr>
<tr>
<td>80 C</td>
<td></td>
<td>-</td>
<td>-15</td>
</tr>
<tr>
<td>70 C, 97 3% RH</td>
<td></td>
<td>-</td>
<td>-15</td>
</tr>
<tr>
<td>Fungi resistance</td>
<td></td>
<td>No growth</td>
<td>-</td>
</tr>
<tr>
<td>Open-cell content, volume</td>
<td>%</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>Surface burning characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flame spread</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance for a 50 mm specimen</td>
<td>m²·K/W</td>
<td>1.20</td>
<td>-</td>
</tr>
<tr>
<td>Time to occupancy</td>
<td>days</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Water absorption by volume</td>
<td>%</td>
<td>-</td>
<td>Declare</td>
</tr>
<tr>
<td>-For materials with WVP ≥ 1400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-For materials with WVP less than 1400 and greater than 400</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water vapour permeance for a 50 mm thick specimen</td>
<td>ng/(Pa·s·m²)</td>
<td>1400 or 400 depending on water absorption</td>
<td>-</td>
</tr>
</tbody>
</table>
Material Standards
Low Density, Open Cell vs. Medium Density, Closed Cell

Differences Between Standards

- Most test methods are the same for both products
- Some test methods conducted on each product that are unique to that product
  - i.e. LTTR, Compressive strength for medium density
  - i.e. Fungi resistance for open cell
Light Density – Open Cell

CAN/ULC S712.2 Installation Standard
Requirements very similar to CAN/ULC S705.2
- In draft at ULC / SPF Task Group level
- Includes items such as on-site testing, substrate preparation, job site set-up, troubleshooting/repair, safety, documentation, etc.
Building Codes

Current Initiatives

- Provincial Code Consultation Input
- Identify code change proposals and develop research priorities with Codes Commission
Research Initiatives

Is Foam a Vapour Barrier?

- Is an Extra Vapour Barrier Required (6 mil poly)
  - CAN/ULC S705.1 requires material must meet Maximum 60 ng/(Pa·s·m²) using ASTM E 96 @ 50 mm thick
  - SPF applied to a substrate (concrete/OSB, etc), vapour permeance decreases
  - University of Waterloo (2 year vapour barrier research project)
Research Initiatives
Is Foam a Vapour Barrier?

- Is an Extra Vapour Barrier Required (6 mil poly)
  - Reviews fibreglass, open-cell foam & medium density closed cell foam in wall assembly with no vapour barrier.
  - Provides test results for various climates across Canada (Vancouver, Winnipeg, Toronto) and various HDD – Heating Degree Days
Research Initiatives

Is Foam a Vapour Barrier?

- Is an Extra Vapour Barrier Required (6 mil poly)
  - Results: no additional vapour barrier required with 2 inches of md-cc foam
  - Vapour barrier required for fibreglass and open-cell foam
  - Assumes water barrier/air barrier
  - Tested wood studs (2 x 4 and 2 x 6 studs) – less than 60 ng
### Maximum Predicted Annual Wood Moisture Content in Walls Subjected to Various Canadian Climates & Interior Relative Humidities

<table>
<thead>
<tr>
<th>Wall Construction</th>
<th>Depth of Cavity</th>
<th>Type of Vapour Control</th>
<th>Vancouver HDD 3000</th>
<th>Toronto HDD 4000</th>
<th>Montreal HDD 4500</th>
<th>Calgary HDD 5000</th>
<th>Winnipeg HDD 6000</th>
<th>Yellowknife HDD 8000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fiberglass</strong></td>
<td>5.5*</td>
<td>Polyethylene sheet</td>
<td>12% 12% 12%</td>
<td>11% 11% 11%</td>
<td>10% 10% 10%</td>
<td>9% 9% 9%</td>
<td>10% 10% 10%</td>
<td>11% 11% 11%</td>
</tr>
<tr>
<td></td>
<td>5.5*</td>
<td>Latex paint + primer</td>
<td>14% 18% 21%</td>
<td>18% 25% 30%</td>
<td>18% 25% 30%</td>
<td>22% 28% 35%</td>
<td>28% 37% 43%</td>
<td>27% 37% 43%</td>
</tr>
<tr>
<td><strong>Studs</strong></td>
<td>3.5” or 5.5”</td>
<td>Latex paint + primer</td>
<td>7% 7% 7%</td>
<td>7% 7% 7%</td>
<td>7% 7% 7%</td>
<td>5% 5% 5%</td>
<td>6% 7% 7%</td>
<td>7% 7% 7%</td>
</tr>
<tr>
<td><strong>Spray Polyurethane</strong></td>
<td>Open Cell</td>
<td>Latex paint + primer</td>
<td>14% 15% 17%</td>
<td>14% 18% 21%</td>
<td>14% 18% 21%</td>
<td>16% 20% 22%</td>
<td>21% 26% 28%</td>
<td>20% 25% 27%</td>
</tr>
<tr>
<td></td>
<td>2”SPF</td>
<td>Latex paint + primer</td>
<td>13% 14% 14%</td>
<td>12% 13% 13%</td>
<td>11% 12% 12%</td>
<td>10% 11% 11%</td>
<td>13% 13% 13%</td>
<td>13% 13% 14%</td>
</tr>
<tr>
<td></td>
<td>2”SPF in 3.5/5.5”</td>
<td>Latex paint + primer</td>
<td>12% 13% 13%</td>
<td>12% 12% 12%</td>
<td>10% 11% 11%</td>
<td>10% 11% 11%</td>
<td>13% 14% 14%</td>
<td>12% 13% 14%</td>
</tr>
<tr>
<td></td>
<td>3.5” SPF in 3.5/5.5”</td>
<td>Latex paint + primer</td>
<td>12% 13% 13%</td>
<td>12% 12% 12%</td>
<td>10% 11% 11%</td>
<td>9% 10% 10%</td>
<td>12% 12% 12%</td>
<td>12% 12% 12%</td>
</tr>
</tbody>
</table>

**Includes Locations (Heating Degree Days):**
- Vancouver (2026)
- Abbotsford (2981)
- Victoria (3040)
- Windsor (9524)
- Niagara Falls (6661)
- Kelowna (3669)
- Ottawa (3917)
- Hamilton (4012)
- Halifax (4000)
- London (4057)
- Toronto (4086)
- Kitchener-Waterloo (4099)
- Kingston (4369)
- Montréal (4519)
- Moncton (4686)
- Ottawa (4802)
- Charlottetown (4715)
- Regina (5060)
- Edmonton (5708)
- Thunder Bay (5717)
- Winnipeg (5777)
- Saskatoon (5952)
- Whitehorse (6811)
- Yellowknife (6825)

**Values in Moisture Content**
- N% = Moisture Content < 20%, no mold growth
- N% = Moisture Content is 20 to 28%, strong potential for moisture problems, reconsider this design
- N% = Moisture Content is over 28%, moisture problems are certain, this design is NOT recommended

**General Notes:**
- Walls are residential wood frame with light colored thin cladding facing north: this is a worse-case scenario for cold-weather diffusion wetting
- Results are for OSB sheathing. Plywood sheathing values will be equal or lower. OSB permeance is always over 60 ng/Pa m2 s in exterior sheathing applications
- Sheathings of DensGlue, FiberBoard, and Gypsum Board are all very vapor permeable and hence will have lower moisture contents
- Thicker foam will always result in lower wintertime sheathing moisture contents
- Effective Air Barrier is assumed to be installed, as is proper rain control
- Closed Cell SPF should be applied in total thicknesses of more than 2” (50 mm), usually in lifts of no more than 10” (50 mm)

**Specific notes:**
1. Apply SPF directly onto back of exterior sheathing
2. RH range indicates the lowest daily interior RH in winter and the highest average daily RH in summer
Research Initiatives

Cathedral Ceilings and Ventilation

- Cathedral Ceilings and Required Venting
  - Is venting required when using a md-cc foam?
  - Code indicates venting is required unless it can be shown to not have an adverse affect
Research Initiatives

- Cathedral Ceilings and Required Venting
  - An airtight assembly is critical in this area
  - MD-CC SPF has been found to provide the required airtightness, vapour performance and protection of exterior wood sheathing.
  - Ontario Municipal Housing and Affairs Branch Opinion issued in 1995 and recent Building Code Commission rulings have indicated that venting is not required
Educational Initiatives

- Building Officials - provincial conferences, local building departments
- Design Professionals – becs, large firms, CSC, CGBC
- Consumers – web, telephone support
- Utilities/Government – eco-energy auditors, utility incentive program
- Our members – foam days, technical documents, members only on website
Educational Initiatives

**Energy Efficiency Contractors' Network**

The Energy Efficiency Contractors' Network in partnership with the Ontario Power Authority (OPA) has created a one-day training workshop to teach contractors how to capitalize on the growing concern for the environment.

Participants of the EECON Training Workshop will receive:
- Comprehensive information about techniques used by energy management firms to identify potential energy efficiency opportunities, quantify the annual energy cost savings and evaluate the capital investment.
- The ability to offer complete services to their customers.
- Access to an exclusive central database of local distribution company incentive programs that are targeted to the SME sector (accessible by both incentive type and geographic location within the province).

For more information on the EECON or training workshop dates and locations, please visit [www.seeon.ca](http://www.seeon.ca).
Marketing Initiatives

- National and Local Print Media
- Website / positioning
- National and Local Trade Shows/ Conferences
- Industry Partnerships
- Project Tracking
Quality Assurance Program
Quality Assurance

CUFCA Quality Assurance Program

• **NEW**: Personnel certification program for sprayers is in compliance with ISO 17024 and accredited by the Standards Council of Canada
SPFA Partnership Opportunities

- Research
- Technical Issues
- Marketing Initiatives
- Education
- Everything