

# Research Plan

## Assessment of the Impact of Air Barriers on Energy and Moisture Control

### Phase 2 of Air Barrier Assembly Evaluations at the Building Envelope System Testing (BEST) Facility

Diana Hun, Ph.D., P.E.  
André Desjarlais  
Achilles Karagiozis, Ph.D.

Oak Ridge National Laboratory

#### Summary

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The goal of the second year of experiments at the Building Envelope System Testing (BEST) facility is to determine the effect of three levels of air leakage rates on energy use in buildings and on the durability of building materials. The air leakage levels to be evaluated at a pressure differential of 75 Pa are:

- Level 1  $\cong 0.02 \text{ L}/(\text{s}\cdot\text{m}^2)$
- Level 2  $\cong 0.2 \text{ L}/(\text{s}\cdot\text{m}^2)$
- Level 3  $\cong 1 \text{ L}/(\text{s}\cdot\text{m}^2)$

These air leakage levels are based on required or recommended values for air barrier materials (Level 1), air barrier assemblies (Level 2), and air barrier systems (Level 3). To this end, this project will assess eight air barrier types that have different application systems, and that are commonly used in residential and/or commercial buildings. Results from this research will improve the energy efficiency of buildings, the durability of building envelopes, and constructions practices.

#### Technical Approach

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Experiments will be conducted at the BEST facility (Figure 1) in Syracuse, NY. Facility features include:

- Indoor temperature and relative humidity set by user
- Exposure of 34 specimens (4' x 9') to indoor and outdoor conditions
- Remotely accessible data acquisition system
- Weather station that measures temperature, relative humidity, solar radiation, rain accumulation, wind speed and direction, and atmospheric pressure



**Figure 1.** Building Envelope System Test (BEST) facility in Syracuse, NY.

The test specimens will consist of wall systems that comply with the 2010 New York State Code requirements for climate zone 5. The materials in the wall panels will be somewhat representative of residential and commercial construction. The typical material layouts in the panels are listed below; the location of the air barrier as well as the inclusion of water-resistive barriers will vary depending on the air barrier type.

Representative of residential construction

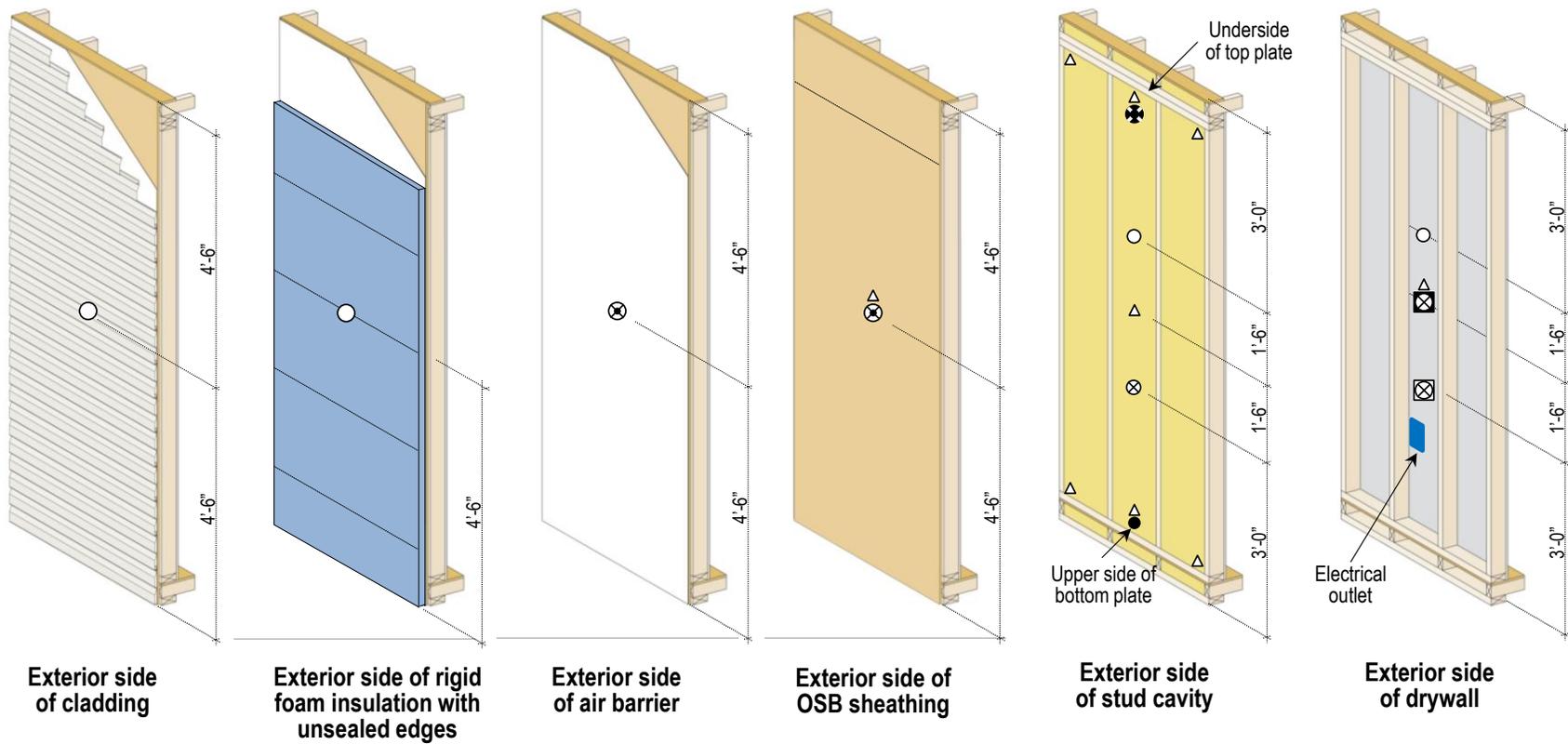
1. Vinyl siding
2. 1 ½” rigid foam insulation (R-7.5) with unsealed edges
3. OSB sheathing
4. 2x4 wood studs at 16” o.c. with R-13 faced batt insulation
5. Drywall with unsealed edges

Representative of commercial construction

1. Fiber cement siding
2. 1 ½” rigid foam insulation (R-7.5) with unsealed edges\*
3. Gypsum sheathing with fiberglass mat
4. 3 ½” steel studs at 16” o.c. with R-13 faced batt insulation\*
5. Drywall with unsealed edges

\* The insulation described in items 2 and 4 will be different in panels with spray-applied foam or rigid foam insulation as the air barrier.

Temperature, relative humidity (RH), heat flux, pressure and moisture content will be monitored at various locations in the specimens for 12 months. Additionally, Syracuse University will study airflow patterns within the wall cavity by measuring tracer gas concentrations at several points within the panels. Figure 2 indicates the typical layout for the sensors, pressure taps and tracer gas taps; note that their location will vary depending on the air barrier type in the wall panel.



- Symbols**
- Temperature
  - △ Tracer gas
  - ⊗ Temperature + RH
  - ⊗ Temperature + RH + pressure
  - ⊗ Temperature + RH + heat flux
  - △ Temperature + moisture pins + tracer gas
  - △ Temperature + RH + pressure + moisture pins + tracer gas
  - △ Temperature + RH + pressure + tracer gas
  - ⊗ Temperature + RH + heat flux + tracer gas + interior temperature

- Number of Sensors**
- Temperature = 12
  - RH = 6
  - Moisture pins = 2
  - Heat flux = 2
  - Pressure taps = 3
  - Tracer gas taps = 9

**Figure 2.** Typical layout of sensors, pressure taps and tracer gas taps in wall specimens

The air barrier types to be studied have different application systems, and are commonly used in residential and/or commercial buildings. The eight types that will be considered are:

1. Fluid applied non-foaming liquid
2. Insulating boardstock
3. Non-insulating boardstock
4. Interior air barrier
5. Mechanically fastened membrane
6. Self-adhered membrane
7. Spray-applied foam
8. Air sealers with back-up structure

The manufacturer for the air barrier type will be blindly selected among the Air Barrier Association of America (ABAA) Project Research Participants. There will be three specimens for each air barrier type; each specimen will be built to represent one of the following air leakage levels when subjected to a pressure differential of 75 Pa:

- Level 1  $\cong 0.02 \text{ L/s.m}^2$
- Level 2  $\cong 0.2 \text{ L/s.m}^2$
- Level 3  $\cong 1 \text{ L/s.m}^2$

These levels were selected because they are required or recommended values for air barrier materials (Level 1), air barrier assemblies (Level 2), and air barrier systems (Level 3). To achieve these airflow rates, flaws will be intentionally introduced into the air barriers. These flaws may include the omission of sealants at air barrier overlaps, the omission of air barrier material at exterior sheathing joints, and/or hardware connections that are installed after the air barrier has been applied. The airflow-pressurization characteristics (i.e.,  $n$ : flow exponent;  $C$ : flow coefficient) will be determined for each specimen right after they are installed in the facility, and every three months afterwards. Actual air leakage rates will then be estimated using the panel characteristics in conjunction with the measured pressure differential across the specimen. Associations will be examined between the actual air leakage rates and heat flux, relative humidity and moisture content measurements. These analyses will be used to estimate the effect of required or recommended air leakage levels at pressure differentials of 75 Pa on energy use in buildings and on the durability of building materials.

## **Timeline**

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The following table describes the project tasks and their tentative timeline.

<b>Task</b>	<b>Date</b>
Build test specimens	March 2011 to June 2011
Collect data	July 2011 to June 2012
Analyze data	July 2012 to November 2012
Issue report	December 2012