Choosing the Appropriate Air Barrier Membrane System

By William F. Foley, CCPR

Massachusetts, Minnesota, Michigan, and Wisconsin all have codes that require the use of an air barrier system that prevents air leakage. Massachusetts was the first state to require air barriers as part of a broad-reaching energy code adopted in July 2001. The code standard essentially mirrors similar code that has been in effect in Canada since 1985.

Even without mandatory code requirements, many architects and owners are designing air barrier systems for buildings across the U.S. The choice of an appropriate air barrier system for a building will depend on a number of factors and variables. The best time for a designer to make this decision is before or during design development. Key variables that go into this decision process are:

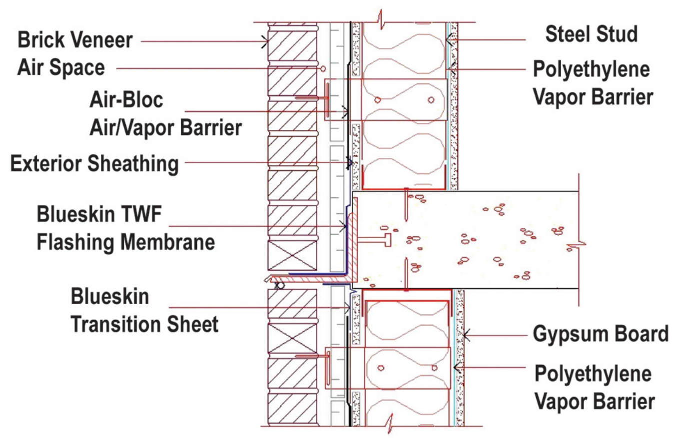
- Exterior climate,
- Interior climate,
- Building design,
- Back-up wall construction,
- Exterior cladding or rain screen system,
- Construction budget,
- Expected building longevity,
- Type and placement of exterior cladding anchors or brick ties,
- Wall design load,
- Insulation placement, and
- Insulation R-value.

Air barrier systems generally fall into several broad categories. In this article, we will focus on the two predominant types of air barrier systems: self-adhering sheet membranes, and cold, fluid-applied membranes.

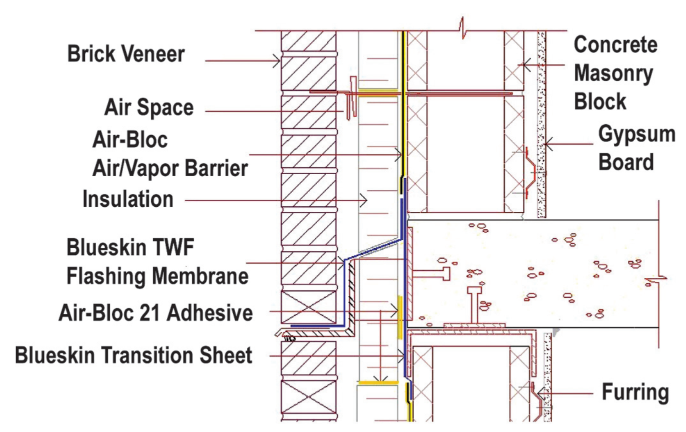
Fluid-applied membranes are differentiated from thin-coating type systems intended primarily for adhered EIFS systems. True membrane air barriers cure to a minimum of 40-mil thickness and are often specified to be thicker than that. Membranes are much better at bridging cracks and joints due to settlement or wind loading because extensibility is dependent on elongation and, more importantly, membrane thickness.

Self-adhered sheet membrane air barriers are always air and vapor barriers.

Cold Climate Permeable Assembly



Cold Climate Non-Permeable Assembly



These details show typical cold climate permeable (left) and non-permeable (right) assemblies.

Is sheet the best solution? Sometimes there is difficulty when using a sheet membrane system with multiple brick ties and penetrations. Fluid-applied systems can be less costly to install and may produce better results in some cases.

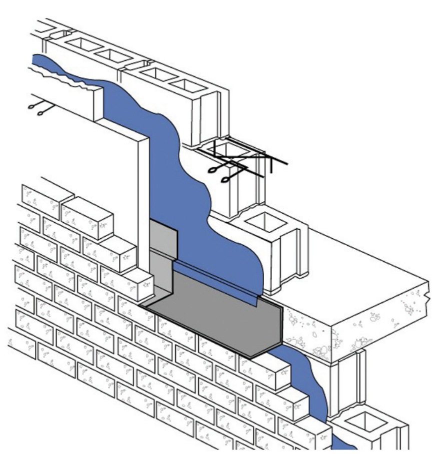
Typically, these are 40 mils thick and are comprised of 36 mils of rubberized asphalt and a 4-mil cross-laminated, HDPE film. These membranes always have a permeance of .01 perms or less.

Cold, fluid-applied air barriers can be air and vapor barriers with a low permeance of less than .01 perms. However, there are also thick, cold, fluid-applied air barriers that have a relatively high permeance to moisture vapor. These materials can have a perm rating from 7 to over 12 perms. Why would a permeable air barrier be preferable to a impermeable air barrier? Actually, there are several answers. Let's look at some of the key variables mentioned above.

Permeable or Non-permeable – Climate

In Canada, Massachusetts, and other northern climates, the "perfect" cavity wall system design is considered to consist of exterior cladding or brick, an air gap, exterior grade insulation, an impermeable air and vapor barrier, CMU or steel studs with weather-resistant sheathing, and no interior batt insulation. This design is considered "perfect" for cold climates because the dewpoint, exterior moisture, and water vapor-laden air are all prevented from entering the building or interior conditioned space.

A similar argument can be made for hot, humid climates like Miami, Florida, with the difference being insulation placement. In Miami, the "perfect" cavity wall system design might be exterior cladding, air gap, non-permeable air and vapor barrier, and CMU with interior insulation or steel stud back-up with interior batt insulation. In the



Isometric drawing of a fluid-applied system on a CMU back-up.

During (below) and after (right) construction shots of the cancer research center at SUNY Albany in Rensselaer, NY, show a system Air-Bloc 33 permeable, fluid-applied air barrier, UV-resistant coating, and a Trespa, METEON composite panel system outboard air barrier. The architect was Einhorn, Yaffe and Prescott of White Plains, NY, and the air barrier subcontractor was Cornerstone Waterproofing of Cooperstown, NY.

deep South, the primary concern is vapor infiltration though diffusion and air movement. Placing the insulation behind the air and vapor barrier usually will prevent condensation within the wall because the dewpoint will never reach the cooler, conditioned interior environment.

Another climate zone in the U.S. is "mixed-humid climate." Think of the Carolinas or Tennessee. In these tricky climate areas, heating degree-days and cooling degree-days are nearly equal. Many experts agree that the best air barrier system for mixed-humid climates are permeable air barriers. These are vapor permeable so that when the dewpoint occasionally is reached on the interior or conditioned side, water vapor is able to escape via diffusion. In fact, many experts also advocate eliminating any vapor barrier within these wall designs because part of the year the vapor barrier will be on the "cold side" or wrong side of the insulation, exacerbating dewpoint and condensation problems. Several cold-applied, permeable air barrier membrane systems are available on the market in the U.S.

Permeable or Impermeable – Insulation Placement and R-Value

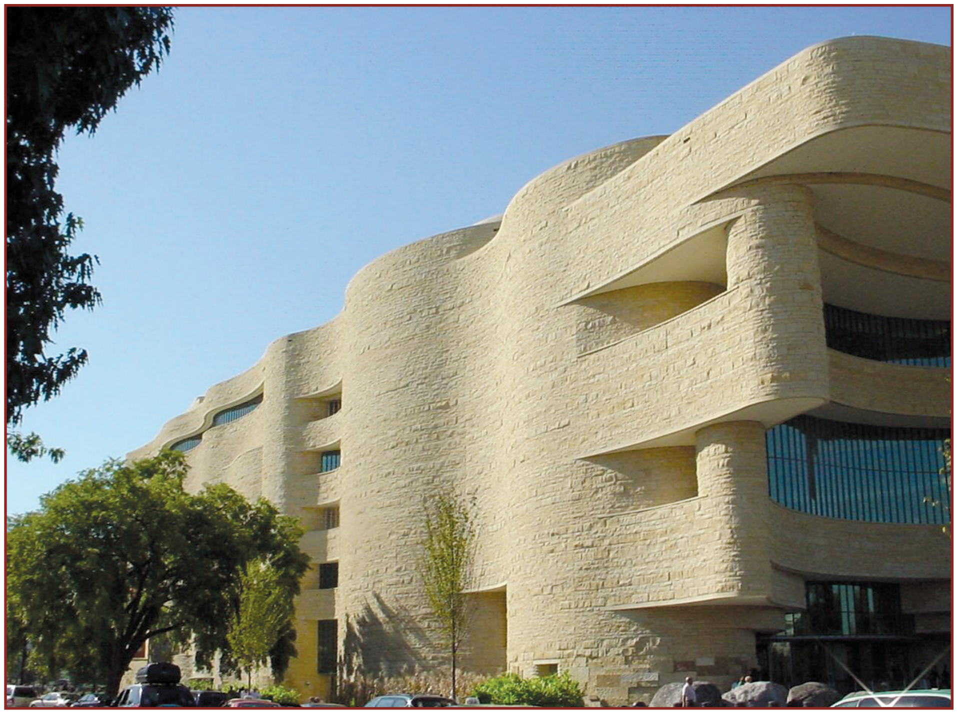
Choosing an air barrier system will depend on insulation placement. This is also related to climate. In northern climates, sometimes it is necessary to place insulation within steel stud framing. In this situation, the air barrier needs to be permeable with a separate vapor barrier on the warm-in-winter side of the interior insulation. There are numerous examples of this type of system in code-driven markets like Massachusetts. Condominiums often opt for this design to increase interior dimensions.

Another reason to select a permeable membrane is for projects with high R-value. In order to achieve R-values in excess of 20, sometimes architects will place R-10 insulation in the exterior cavity side and also use R-19 batt insulation on the interior side. Running a dewpoint analysis or a hydrothermal analysis program like "WUFI" will show that an impermeable air barrier should never be used in the middle of two layers of insulation. Experts also suggest that for borderline, hot, humid climates with exterior insulation, permeable membranes are the best choice.

Sheet Membrane or Fluid-applied?

Once the decision is made whether the air barrier system should be permeable or impermeable, then there are other criteria

The National Museum of the American Indian (NMAI) is a new Smithsonian Museum in Washington, DC. The Smith Group was the architect for the building, which used a Blueskin SA sheet membrane air/vapor barrier with BASF sprayed urethane foam insulation behind sandstone.



that would influence a choice between cold fluid applied systems and sheet membrane systems.

Some cold, fluid-applied systems have other specific physical properties that will affect a choice of materials. One product available in the marketplace today is a permeable and UV-resistant product. In open-jointed-panel, rain screen systems such as METEON® by Trespa, UV resistance is often required because the membrane will be permanently exposed to some UV light that would deteriorate other membranes. Because UV-resistant membranes are almost always applied outboard of insulation, these products also must be permeable. Sheet membranes are always impermeable and are not generally UV resistant and, therefore, are inappropriate in this application.

Other cold, fluid-applied products are fire resistant. Fire resistance with low flame spread and smoke developed ratings are often requirements for interior applied air and vapor barrier systems. In cities like New York or Chicago, there is some thinking that even exterior applied membranes should be fire resistant to prevent a possible chimney affect in multi-story cavity wall conditions. Rubberized, asphalt-based sheet membrane systems inherently have high flame spread and smoke-developed ratings and should not be specified when fire resistance is a concern.

Lastly, some impermeable fluid systems also serve as insulation adhesive in addition to being air and vapor barriers. This is particularly beneficial in preventing cold air from migrating behind the exterior insulation, resulting in thermal shorts. This approach is also cost effective in eliminating additional mechanical fasteners or another separate adhesive. The New York City School Construction Authority has chosen to specify an impermeable, adhesive-type system on CMU as part of an energy upgrade over previously specified dampproofing.

Brick Ties and Other Penetrations

In non-permeable designs, the choice between a cold, fluid-applied system and a sheet membrane system usually comes down to installed cost. Sheet membranes, in general, cost less per square foot of material only – often as much as $0.50 per square foot less. In very straightforward applications with few penetrations and post-applied brick ties or anchors, sheet membrane systems are often less expensive than fluid-applied systems on an installed

The Marina Bay Tower in Quincy, MA, used Georgia Pacific's DensGlass Gold Sheathing (yellow in photo), Henry's Air-bloc 31 membrane (a liquid emulsion, vapor-permeable air barrier), Dow 1" extruded polystyrene insulation (light blue), and an Alucobond panel system. It is also shown on the cover of this publication.

cost basis. In high labor cost markets, this price differential tends to skew back toward fluid-applied membranes because of the speed of application.

It's important to understand that all membrane systems – whether sheet or fluid-applied – universally use sheets or cut, tape-size sheets for critical details, cold joints, and other membrane transitions. So for designers who are concerned about uniform thickness and workmanship, sheet systems and fluid-applied systems should perform equally well.

When doing projects with brick ties already in place, the least costly system and perhaps better-sealed air barrier system will invariably be a fluid-applied system. Cutting sheets around brick ties requires meticulous workmanship to prevent fishmouths and holes. Even when done properly, a fluid sealant is prescribed around penetrations. Needless to say, it is easy to see why using a fluid system on a wall full of ties makes the most sense.

At Hawk Mountain Sanctuary, Orwigsburg, PA, the walls on either end of the building leaked water and air. Stone was removed and Air-Bloc 32 added on previously bare CMU block back-up walls. The leaks stopped. Assembly included exterior Foamular insulation, Mortar Net, and reapplication of the stones. Architect: Spillman Farmer Architects, Bethlehem, PA; Contractor: Schelgel Contracting. Product: Air-Bloc 32 non-permeable, fluid-applied; retrofit vapor barrier, air barrier, and waterproofing; Grace Perm-A-Barrier compatible with through-wall flashing.

Conclusions

The choice to use a true membrane air barrier system for a building is excellent for obvious reasons. Choosing the appropriate product starts with getting the best advice possible.

Design professionals – including architects and consultants – rely upon qualified manufacturers' product representatives. During the design process, manufacturers might offer a hydrothermal analysis or dew-point analysis that can help determine whether a permeable or impermeable material is best suited.

A knowledgeable product representative will not try to force fit a impermeable system that clearly should have a permeable membrane. Likewise, a helpful product representative will listen to the architect's design criteria, including budget and complementary building components, to help select the appropriate product.

Most building envelope consultants have been working with air barrier systems and moisture control through wall assemblies for many years and often decades. Architects and building owners may employ a consultant directly to assist in their wall assembly design. Consultants will often continue their contracted involvement through the bid and submittal review process and construction administration.

Once a suitable design is chosen, specified, and bid, the best air barrier manufacturers will join the consultant by attending pre-construction meetings as well as providing separate on-site observations. Air barriers as systems depend upon proper installation. Contracting with a qualified consulting firm will ensure the entire building envelope, including the air barrier, is successfully installed. The most effective air barrier system will be the one that is supplied by a recognized air barrier manufacturer, properly installed by a qualified air barrier installation contractor, and overseen by a qualified building envelope consultant.

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William F. Foley, CCPR, has been active in commercial construction for more than 25 years. For the last 18 years, Bill has worked in waterproofing, roofing, and air barrier sales and product management. Since early 2001, Foley has been involved in the advancement of air barrier technology in the U.S. As of December 2003, he joined the Henry Company as a regional manager for the Eastern U.S. for building envelope systems.

ERA PUBLISHES LEED ROOFING BULLETIN

An interpretation of the guidelines for the U.S. Green Building Council's LEED™ Rating System as applied to roofing standards is now available on the EPDM Roofing Association's (ERA) Web site at **www.epdmroofs.org**.

The bulletin explains how roofing systems can impact the types of voluntary green building standards for commercial applications that are available from the USGBC, including: LEED-NC, Version 2.1 for New Construction and Major Renovations; LEED-EB for Existing Buildings; and LEED-CS for Core and Shell Development. Templates for reporting the attributes of an EPDM roofing system also can be found online at the site's LEED information area.