Frequently Asked Questions About Air Barriers

By Paul Grahovac

They're called air barriers, but reducing energy costs and keeping water – liquid or vapor – out of wall assemblies is really what they're all about. And when water does get in, as it is likely to do sometime during construction and duringthe life of a building, an air barrier needs to allow the water to evaporate out again.

Most construction professionals know what happens when water is trapped in walls. We get conditions for mold, corrosion, and reduced R-value. When these things occur, those who designed and built the structure come under uncomfortable scrutiny. So it's a good idea for design and construction firms to clearly understand the purposes and functions of air barriers in wall assemblies.

The problem is that there is a vast array of air barrier products on the market. Multiply the number of air barrier products by the number of wall assembly types, and we get an almost limitless range of scenarios for air barriers. It's no wonder that even the professionals have questions. Here are some of the most common – with the answers.

Q. What's the problem with air movement in and out of wall assemblies?

When air leaks in and out of a building, the building owner's energy bills go up. The HVAC system has to work harder to compensate, which shortens its service life. Another problem is that when the escaping warm air meets colder temperatures on its way out, it may deposit its moisture as condensation inside the wall. If the wall can't dry out, mold may result.

In summer, warm, moist air from outside leaking in can encounter surfaces chilled by interior air conditioning and, again, deposit its moisture as condensation. Cold pipes can cause condensation also.

Air barriers stop air from escaping with the building owner's energy dollars and reduce the chance of warm air meeting cold surfaces.

Vapor-permeable air barriers stop destructive air flow but permit evaporation in case water does get into walls. Wall assemblies that can dry out are much less prone to foster mold, even if they do get wet – from a leaky pipe, for example.

Q. Structural walls using Densglass®, plywood, and CMU already keep air from penetrating the wall assembly. So why do they need an additional air barrier?

It's true that individual panels of Densglass® and plywood impede air movement. However, air can get in and out through the seams between the panels. Concrete Masonry Units (CMU) have been proven in laboratory tests to be remarkably air-permeable.

Effective air barrier products are required to completely prevent air penetration through all three of these and other structural-wall materials.

Q. If the object is to keep water vapor out of walls, doesn't it make sense to use a vapor barrier?

The problem with this approach is that vapor barriers stop vapor movement both ways. So if water or water vapor does happen to get in the wall, a vapor-impermeable barrier will keep it there.

Q. Wouldn't using both a vapor barrier and an air barrier cover all bases?

With a correctly installed and effective air barrier, a vapor barrier is unnecessary. The experts at the Association of the Wall and Ceiling Industry (AWCI) have extensive experience in mold litigation. Here's what they say:

> *Whether or not to install a vapor barrier has been a point of confusion and debate – not just among designers and builders, but also among the various building codes. After considering the various opinions, the most effective approach appears to be not installing a separate vapor barrier [in addition to the recommended air barrier]. Moisture trapped between two materials that act as vapor barriers cannot escape and thus condenses inside the ceiling or wall at the cold surface.*[1]

Q. Can condensation in the wall assembly be avoided by insulating the vapor barrier?

Sure – until the insulation starts to detach, as it often does. In fact, vapor barrier manufacturers typically recommend covering their products with cavity insulation. They recognize that water vapor trapped in the envelope by an external vapor barrier will tend to condense in the envelope if cold outdoor air contacts and chills the vapor barrier.

The problem is that this solution is only as good as the

A mason installs a brick veneer over sheathing coated with a water-based, fluid-applied air barrier. (Photo, courtesy PROSOCO.)

This opening in the masonry veneer lets warm, moist air into the building envelope. If it finds its way through the structural wall, there is danger of condensation in the cooler recesses of the wall assembly. Condensation creates conditions for mold and other wall-component deterioration. Air barriers stop the air flow at the structural walls. (Photo, courtesy PROSOCO.)

Wall penetrations, like this one for an electrical conduit, serve as both an entrance and exit for air-carried moisture. In cold weather, warm, conditioned air from living spaces can escape through gaps and seams in the wall assembly, exiting here, with the building owner's energy dollars. In hot weather, warm, humid air can enter. In both cases, when the air hits surfaces cool enough, it will drop its load of water vapor as liquid condensation. That's the first step in creating conditions for mold. (Photo, courtesy PROSOCO.)

tape or glue holding the insulation in place. An eventual failure leads to cold spots on the vapor barrier and condensation inside the building envelope – and conditions for mold growth and other wall-assembly deterioration when the assembly can't dry out.

Still insist on a vapor barrier system despite the risks? Specify extruded polystyrene to go onto a vapor-permeable air barrier. Extruded polystyrene is vapor-impermeable. If it stays in place, it provides a vapor barrier. If the extruded polystyrene doesn't stay in place, condensation in the envelope is avoided because the air barrier is vapor-permeable.

Q. Is there any advantage to insulating a vapor-permeable air barrier?

No. Whether the insulation stays on or peels off, it won't noticeably affect the vapor-permeable air barrier's performance.

If cavity insulation is still desirable for its added R-value, specify expanded polystyrene, also known as EPS or "beadboard." It is vapor permeable.

Q. How does water get into the wall despite a vapor barrier or air barrier?

There are many ways. Some walls get wet from precipitation during construction and haven't fully dried before construction wraps up. Walls are still vulnerable to moisture even after construction. In the heating season, for instance, large volumes of warm, moist air exfiltrate from living spaces outward into the wall assembly. Electrical and plumbing penetrations are prime conduits. That exfiltration begins almost from the moment people move into the building.

Water can also enter from burst or leaky pipes, roof flashing failure, and leaky seams under coping caps, just to name a few ways. There's always the risk these failures will happen sooner or later – perhaps not for 10 years, with luck. When they do happen, though, the water has to be able to escape.

Q. Since vapor barriers stop air movement into and out of the wall assembly, doesn't that make them air barriers also?

Yes. The true distinction is between vapor-permeable and vapor-impermeable air barriers. Vapor-impermeable air barriers are often referred to as "vapor barriers" or "vapor retarders."

Under a sink, pipes penetrate the wall assembly. Even though the gaps seem tiny, for air, they are a superhighway. If there is a pathway to the outdoors, expensively conditioned air will blow out just the same as if someone opened a door or window. Air barriers block those pathways. (Photo, courtesy PROSOCO.)

Q. Won't vapor-permeable air barriers let water vapor into the wall assembly and then let it evaporate out again?

Yes. However, studies have shown that the amount of vapor getting in by permeating the air barrier is insignificant. The U.S. Department of Energy estimates 1.3 percent of vapor intrusion is by diffusion, with the rest coming in via air transport.[2] Air that leaks in and out through sheathing seams, CMU, roof and foundation connections, rough openings, and other penetrations, directly or indirectly, is what causes problems. That air often carries large amounts of water vapor. Even the air in relatively dry climates carries more water vapor than one might think. Hundreds of times more water vapor gets into walls through air leaks than by vapor permeating the wall assembly materials.

Stopping air leaks is what's important. Stopping water-vapor diffusion through walls harms buildings in the long run because it traps water in the walls.

Q. How did vapor barriers get started in the construction industry?

Construction professionals have long used impermeable vapor barriers, such as rubberized asphalt sheets, to waterproof below-grade foundations and roof assemblies. When they found water vapor moving through walls was a problem, they immediately turned to impermeable vapor barriers.

Since then, experience has shown that wall assemblies need to be vapor-permeable to avoid trapping water vapor. Although they need to be vapor-permeable, walls must not allow air leakage.

Air leaks in walls are a prime cause of high energy bills from excessive heating and cooling loads. They also let warm, moist outside air leak into the wall assembly to possibly condense on cold pipes or on wall components chilled by air conditioning.

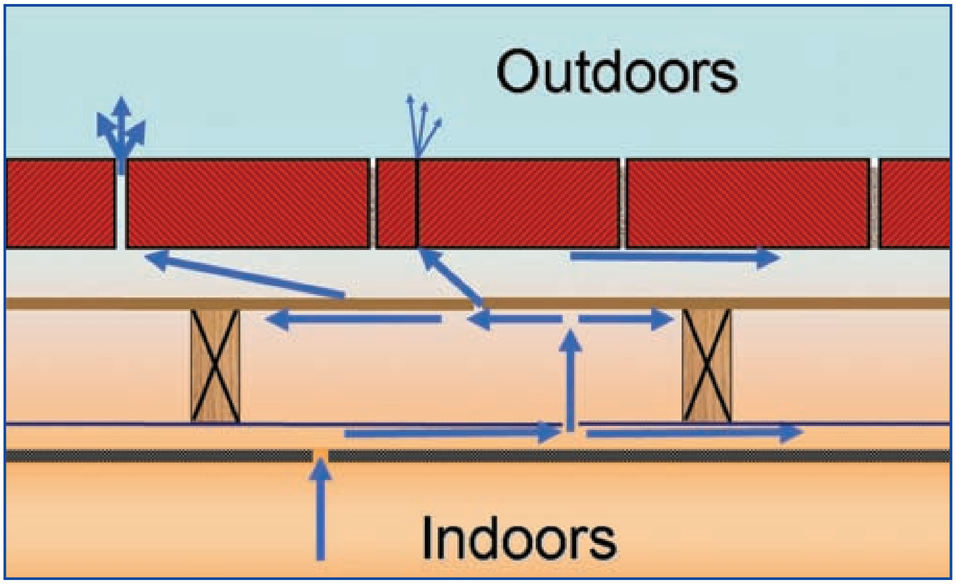
Q. Fluid-applied air barriers are all over the map as far as thickness of application. I've seen everything from 10 mils to 120 mils. What are the pros and cons of thin vs. thick?

The first consideration must always be: does the product stop air leaks and let water vapor evaporate out of the wall? Thin vs. thick doesn't matter if these checkpoints aren't met. If they are met, then a thinner application is preferable. Thinner applications mean easier installation and touch-ups, quicker completion, and less material used.

Q. Are solvent-based or water-based, fluid-applied products more effective?

If installed according to the manufacturer's recommendation, both types will probably do the job. To choose, one must ask: does the product comply with federal, state, and local VOC (volatile organic compound) regulations? At one time, California was the only state that had stricter VOC regulations for architectural coatings than the national standard. Now, more and more states – primarily Northeast and Mid-Atlantic – are implementing regulations similar to California's. Solvent-based products may not be allowed.

Also, in general, water-based products will be easier and safer to apply – two considerations that impact worker safety and cost, which are always important.



This top-down view of the wall assembly shows the tiny, tortuous path that inside air takes to get outside. Anywhere there is the smallest breach in the wall assembly, including seams between sheathing panels, the air can go through, carrying the building owner's energy dollars with it. (Photo, courtesy PROSOCO.)

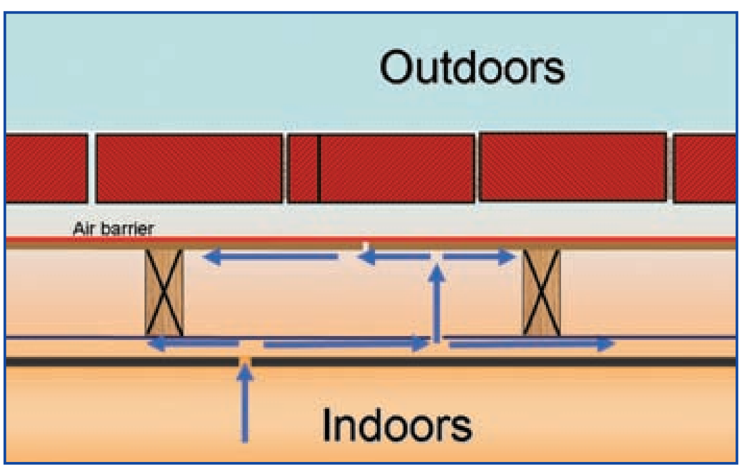
Q. Some air barriers are advertised as "water-resistive." What is that, and how important is it?

It's a technical way of saying that water can't soak into the air barrier, and it will protect the substrate. The water-resistive air barrier doubles as a secondary drainage plane, which is often required by code or specification. Make sure the air barrier is also code-approved as a water-resistive barrier.

Q. How important is it for air barriers to be resistant to weathering and ultraviolet rays?

Since air barriers are designed to be inside a wall assembly, resistance to outdoor conditions is not their number-one priority. Construction delays, however, can result in an air barrier being exposed for extended periods.

A quick survey of the market reveals products that claim to resist weathering and UV resistance for seven days, 30 days, six weeks, 60 days, 73 days, and six months. Exceeding exposure time can result in a damaged and ineffective air barrier. Specifications may call for removal and replacement of air barriers that have exceeded their exposure limit. In general, the longer a product can withstand exposure, the better.



This top-down view of the wall assembly shows how an air barrier located on the external sheathing stops uncontrolled movement of air through the wall assembly. A recent study by the National Institute of Standards and Technology (NIST) revealed that more than 40 percent of a building's heating and cooling costs can be wasted by such uncontrolled movement of air. (Photo, courtesy PROSOCO.)

Building Envelope Knowledge Assessment

Test your knowledge with the following questions developed by Donald E. Bush Jr., RRC.

1. **How does a curtain-wall or window-system design allow for the thermal movement of materials of different thermal expansion coefficients?**
2. **Describe the method used to wet-glaze failed, shrunken, and dry-glazing gaskets at a window unit.**
3. **What is the purpose of end dams in a glass curtain-wall system?**
4. **What are the two major movements that occur on newly laid brick veneer?**
5. **What are the most common causes of adhesive failure at a sealant joint?**

Answers on page 12

Answers to questions from page 11:

1. **Properly designed sealant joints and the right sealant will accommodate the movement.**
2. **Cut dry gasket to form a 90-degree angle between window glass and metal. Wipe glass and metal with solvent to clean substrate. Install silicone sealant with ± 50% movement rating. Tool fillet bead to ensure a complete seal.**
3. **They contain any water within the aluminum channels at the horizontal/ vertical intersection and route the water out through the window weep system.**
4. **A. Thermal Movement – brick can expand and contract approximately 0.45 inch per 100 linear feet within a 100°F temperature swing.**
   B. Moisture Movement – initial moisture expansion of dry, new brick may age up to 18 months before a relative degree of stability occurs.
5. **Improper surface preparation, substrate contamination, and improperly tooled sealant.**

Reference: ***SWRI Waterproofing Manual***

Cost Per Square Foot Over Glass, Mat-faced Gypsum Chicago Illinois - 2005

PRODUCT	LABOR	MATERIAL	INSTALLED COST
Fluid-applied, single coat	$.56 - $1.00	$.50	$1.06 - $1.56
Commercial fabric wrap*	$.50 - $.75	$.16	$.66 - $.93
Two-component, synthetic rubber, fluid-applied	$1.25 - $1.75	$.75 - $1.00	$2.00 - $2.75
Self-adhering, rubberized asphalt membrane	$1.50 - $2.25	$.50 - $.75	$2.00 - $3.00
One-component, liquid-applied, rubberized membrane	$1.50 - $2.00	$1.25 - $1.35	$2.75 - $3.00

*Does not include cost of proper installation of fabric wrap with cap fasteners, flashing tape, and seam tape.

Table 1

Q. How do the different types of air barriers compare cost-wise?

In 2005, an informal survey of the Chicago market for commercial sheathing applications (union labor) provided rough cost comparisons applicable to these types of products. Check actual local prices specific to a given project and the products being considered. See *Table 1*.

Q. How much can an air barrier reduce a building's energy costs?

According to a recent study by the National Institute of Standards and Technology (NIST), a correctly installed air barrier can save more than 40 percent of a building's heating and cooling costs.[3] That's how much energy can be wasted by uncontrolled air movement through wall assemblies.

Footnotes

1. *Mold: Cause, Effect, and Response*, Chelsea Group, for the Foundation of the Wall and Ceiling Industry, p. 33.
2. www.eere.energy.gov/buildings/info/documents/pdfs/28600.pdf.
3. Emmerich, S. J.; McDowell, T.; Anis, W., "Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use," National Institute of Standards and Technology, *NIST IR 7238*, June 2005.

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