

Air Barriers: Increasing Building Performance, Decreasing Energy Costs

Provided by DuPont Tyvek

Controlling air leakage is an important factor in maintaining a building's energy efficiency. According to the United States Department of Energy, some 40 percent of the energy of heating and cooling a building is lost by uncontrolled air leakage through the building enclosure. As a result, North American energy codes have started to address airtight qualities in buildings. Uncontrolled air leakage could have consequences beyond increased energy consumption, regarding health and safety of the building occupants, as well as premature deterioration of building materials.

This article will focus on air barrier membranes, which are materials specifically designed to control airflow. Lightweight, yet strong, air barrier membranes can control unwanted air leakage

Lightweight, yet strong, air barrier membranes can control unwanted air leakage and create an airtight building, while enhancing the comfort of interior environments, building envelope durability, and energy efficiency in a way that's cost effective and visually unobtrusive. And the payoff in energy savings can be significant.

and create an airtight building, while enhancing the comfort of interior environments, building envelope durability, and energy efficiency in a way that's cost effective and visually unobtrusive. And the payoff in energy savings can be significant. A 2005 National Institute of Standards and Technology (NIST) study indicates that an air barrier system could reduce air leakage by up to 85 percent, and realize a 40 percent savings in natural gas, and a 25 percent savings in electricity.

The energy implications of air barriers are significant," says Peter J. Arsenault, AIA, NCARB, LEED-AP, principal of Peter J. Arsenault Architect in Syracuse, New York. "Air infiltration in a building can account for a nearly equal degree of energy loss as insulation values. In other words, R-values and insulation details account for about half of the heating and cooling energy use in a building. The other half is lost to air infiltration. Tests have shown a significant decrease in air infiltration with proper installation of air barriers."

CODES AND LEGISLATION RELATING TO AIR BARRIERS

Air barrier systems provide several advantages for building projects, including increased interior comfort, durability and energy efficiency. With these attributes, they are suitable for a variety of applications in various climates.

Air barriers have the potential to reduce air leakage to acceptable levels for less than \$1.50/square foot of gross building area, and are often specified for buildings. Air barriers are typically regulated through energy codes, which recognize the importance of airtight buildings and energy efficiency. As of early 2006, several states have developed existing and pending legislation on air barriers, as well as compliance criteria.



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Use the learning objectives below to focus your study as you read **Air Barriers: Increasing Building Performance, Decreasing Energy Costs**. To earn one AIA/CES Learning Unit, including one hour of health, safety, welfare credit, answer the questions on page 211, then follow the reporting instructions on page 224 or go to the Continuing Education section on archrecord.construction.com and follow the reporting instructions.

LEARNING OBJECTIVES

After reading this article, you should be able to:

- Explain recent trends in air barriers for buildings.
- Understand the physics of air and moisture movement through the building enclosure.
- Discuss air barrier functions, benefits and performance requirements.
- Select the appropriate air barrier for building projects.

Summary of Existing and Proposed Energy Codes

Codes & Regulations	Compliance Requirements Air Infiltration, cfm/ft ² @ 0.30 in water (75Pa)		
	Material ASTM E2178	Assembly ASTM E1677	Whole Bldg. ASTM E779
The National Building Code of Canada (1995 NBC)	0.004	--	--
Massachusetts Energy Code (July 2001)	0.004	--	--
WI Energy Code	--	0.06	--
MN Energy Code (Proposal)	0.004	--	--
ASHRAE 90.1* (Proposal approved 2005)	0.004	0.04	0.4

* ASHRAE proposal has 3 compliance options: Material, Assembly, or Whole Building. Summary of existing and proposed energy codes

The 1995 National Building Code of Canada (NBC code) requires a continuous air barrier for all commercial buildings. Massachusetts was the first state to adopt an energy code, in 2001, which is similar to the NBC code, and requires a continuous air barrier for commercial buildings. Wisconsin adopted an energy code in 2003. Minnesota is developing an energy code in early 2006, with similar compliance criteria as the Massachusetts energy code. In addition, as of 2003, the Envelope Design Guidelines for Federal Office Buildings and Multi-Family High Rise Residential Buildings require air barriers.

As air barriers are better understood and the benefits are documented, more jurisdictions will likely be following suit. In 2005, the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) approved an amendment to the ASHRAE 90.1 model energy code that would require an air barrier for most commercial buildings in most climate zones. With their clear advantages and the imminent code requirements, it's critical that architects understand the air barrier functions and benefits, and how to specify them.

THE PHYSICS OF AIR AND MOISTURE TRANSPORT THROUGH THE BUILDING ENCLOSURE

To gain a proper working understanding of the role of air barriers in building enclosures, some basic terminology and fundamental physics must first be defined. The building enclosure, also known as the building envelope, refers to the part of the building that physically separates the interior conditioned space from the exterior environment. Its main function is to control all loadings due to separation of the two environments, the flow of mass and flow of energy. Air barriers are an important component of the building enclosure.

Air Leakage

Air leakage through the building enclosure refers to the unplanned, unpredictable, and unintentional airflow in or out of buildings, and must be distinguished from the intentional and, ideally, controlled flow of outdoor air into a building via either a mechanical or a ventilation system. A building can be very tight in terms of air leakage and have sufficient ventilation; conversely, a building could be very leaky and have insufficient ventilation. In mechanically ventilated buildings, it is desirable to have an airtight building enclosure, which is achieved by connecting materials with high air infiltration resistance into a continuous air barrier system.

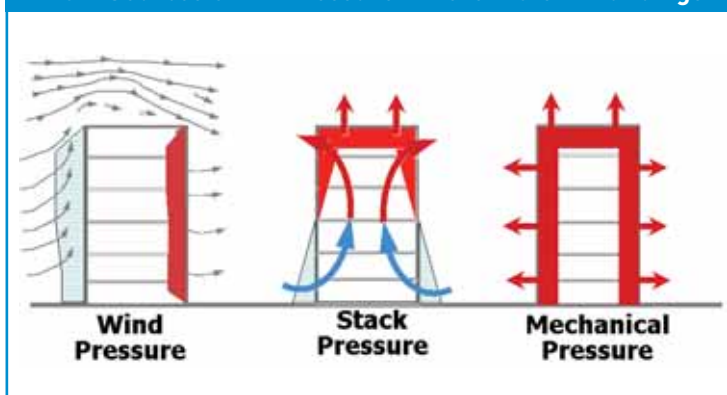
In order for air leakage to occur, there must be a driving force and a pathway. *The driving force* for air leakage is the difference in total air pressure across the building enclosure, with airflow occurring from higher to lower pressure, or from positive to negative pressure. There are three main sources of air pressure difference.

The wind pressure is a significant factor and it is usually high (positive) on the windward side, and low (negative) on the leeward side of the building. When averaged over the course of a year, industry experts estimate that wind pressure is about 10 to 15 miles per hour (0.2 to 0.3 pounds per square foot) in most locations in North America.

Stack pressure (also called chimney effect or buoyancy) is caused by the atmospheric pressure difference between the top and bottom of a building, which is in turn caused by the temperature difference and hence the difference in the weight of the columns of indoor and outdoor air. In cold climates, during winter, the stack effect can cause infiltration of cold air at the bottom and exfiltration of warmer air at the top of the building. The reverse occurs in summer, with air conditioning.

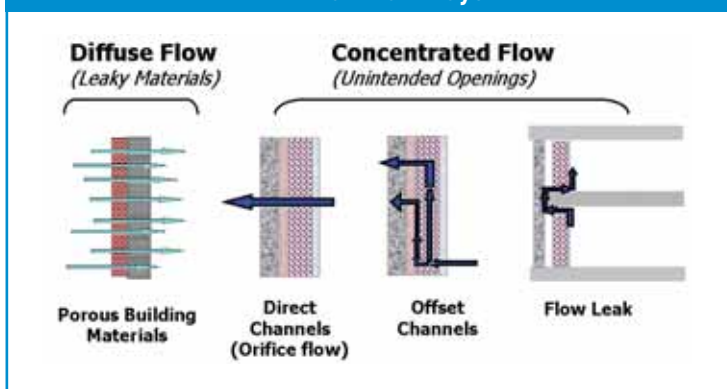
Mechanical pressure is caused by heating, ventilation and air conditioning (HVAC) system pressurization. HVAC engineers tend to design buildings with slight positive pressures in order to reduce infiltration and associated pollution. However, this practice might not be ideal in some climates, such as in cold climates.

Main Sources of Air Pressure Differentials in Buildings



The main types of *airflow pathways* include diffuse flow and concentrated pathways. Diffuse flow occurs through leaky materials and assemblies, such as fibrous insulation, uncoated masonry (such as concrete masonry units and brick), or other porous building materials. Concentrated flow occurs through unintended openings. Direct channel flow or orifice flow, which occurs when the air enters and exits in a direct path, has the highest cost penalty because of high energy loss. Offset channel leaks are the most damaging because of longer pathways, which allow for air to change its temperature and to reach the dew point within the building enclosure leading to interstitial condensation. Flow leaks occur between floors and could add to stack effect.

Air Flow Pathways



Moisture Transport

Moisture moves through the building enclosure as *liquid water* or as *water vapors*. The difference between the two physical states of water is the size of the molecular aggregates: liquid water exists as large molecular aggregates (up to 100 molecules at room temperature), while water vapors exist as free molecules. Consequently, the transport mechanisms are different for liquid water and water vapors.

Liquid water

The main source of liquid water for above grade walls is rain, which can infiltrate behind the exterior cladding and be driven into the building enclosure by four main forces:

Gravity can draw water down through openings and cracks, and into the construction assembly.

Capillary forces act like a sponge sucking water through small cracks and pores. Smaller cracks result in greater capillary forces.

Rain droplets can pass through openings in the exterior cladding, driven by the momentum of falling rain drops.

The pressure differential can push or suck water through openings and cracks, into the construction assembly.

There are three basic types of exterior wall design, from the standpoint of rain penetration control.

- *Face-sealed (barrier) walls* rely upon every seam and crack to be face sealed. This design requires detailed workmanship and continuous maintenance, and is most vulnerable to rain infiltration. This design is effective only in areas with low wind and rain exposure. Examples of barrier walls include non-drainage Exterior Insulation Finish Systems (EIFS) and face-sealed curtain walls.
- *Concealed barrier walls* rely on multiple layers for rain penetration control. In contrast to face-sealed systems, these walls include a drainage plane within the wall assembly that functions as a second line of defense against water intrusion. The drainage plane is usually a water resistive barrier membrane. This design is effective in areas with moderate wind and rain exposure. A typical example of a concealed barrier wall is the drainage stucco system.
- *Drained cavity or rain screen walls* rely on two layers and a drained cavity space for rain penetration control. This design is similar to the concealed barrier system in that it provides two lines of defense, but it offers additional features, such as capillary breaks between porous materials, freer drainage, and venting or ventilation to limit average relative humidity (RH) outside of sheathing. This design is most effective in rain penetration control and should be used in areas with high wind and rain exposure. Examples of rain screen walls include brick-veneer cavity walls, furred-out clapboard walls, and drainable EIFS walls.

Water vapor can be transported through the building enclosure by *air currents* and by *vapor diffusion*. Air currents could carry significant amount of moisture vapors into the building enclosure. A continuous air barrier will control airflow, hence the moisture migration through air currents. Air-transported moisture must not be confused with vapor diffusion.

For water vapor diffusion to occur there has to be a driving force and a pathway. The driving force for water vapor diffusion is the difference in water vapor concentration or difference in vapor pressure across an assembly: water vapors flow from an area of higher concentration (higher vapor pressure) to an area of lower concentration (lower vapor pressure). The ability of materials to allow vapor diffusion is measured by vapor permeability, which is expressed in perms: the higher the perms, the higher the vapor permeability.

The 2003 International Building Code (IBC) classifies building materials into vapor permeable (greater than five perms) and *vapor non-permeable* (less than one perm). *Vapor non-permeable* materials are called vapor barriers or vapor retarders. Other terms often used to describe vapor permeable or non-permeable materials are “*breathable*” and “*non-breathable*,” respectively.

“Breathability is often associated with air flow, rather than moisture vapor flow,” notes Maria Spinu, Ph.D., Building Science Manager, Dupont Building Innovation. “The use of this terminology may have contributed to the confusion between an air barrier versus a vapor barrier function.” While the two functions could be performed by a single material, providing an air and vapor barrier, the needs addressed are quite different. Air barriers retard airflow, which is the result of air pressure differences. Vapor barriers retard water vapor flow, which is the result of water vapor concentration differences.

Experts estimate that the amount of moisture vapor transported by air currents can be 100 to 200 times higher than the amount transported by vapor diffusion, and can account for more than 98 percent of all water vapor movement through the building enclosure.

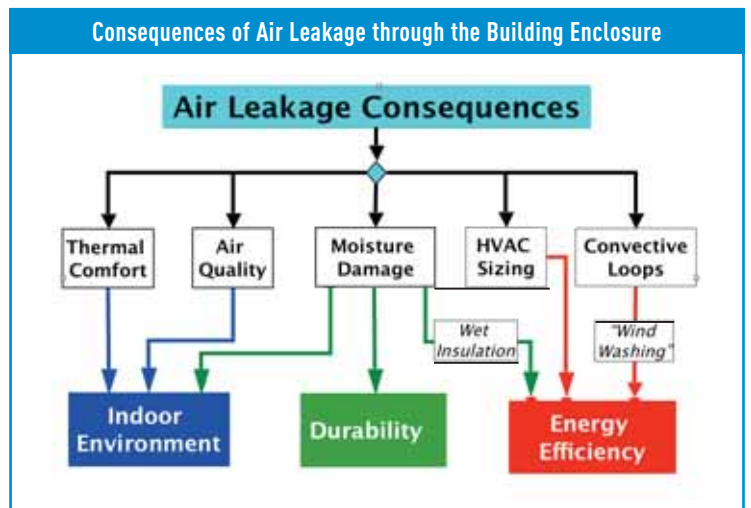
In summary, there are three main moisture sources, which could lead to water problems in buildings: bulk water, air transported moisture, and vapor diffusion. “The three moisture sources do not contribute equally to the wetting of the building enclosure,” says Spinu. Liquid or bulk water infiltration is usually the largest wetting source for above-grade walls, followed by air transported moisture, which is significantly higher than the amount of water vapor transported by diffusion. It is generally accepted that the buildings will occasionally get wet; however, moisture problems in buildings will occur if wetting exceeds drying. Consequently, in order to prevent moisture problems it is essential to protect the enclosure against wetting and promote drying. Although moisture movement by diffusion cannot be discounted as a wetting source, it should not be the primary focus for moisture intrusion control; vapor diffusion, however, is critical for drying.

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AIR BARRIER FUNCTIONS AND BENEFITS

Uncontrolled air leakage could negatively impact building occupant comfort, durability of building materials, and energy consumption levels. Air barriers play a critical role in controlling these effects of air leakage.

The primary function of an air barrier is to control air leakage in order to avoid undesirable consequences.



Air movement can create drafts affecting thermal comfort, or carry contaminants and moisture through the building enclosure, affecting indoor air quality and safety of the occupants. Excess moisture can also condense on interior surfaces and cause premature degradation of building materials, such as corrosion of metal and rotting of wood. Unintentional air leakage could lead to increased energy use in at least three different ways: over sizing of HVAC equipment to compensate for the heating and cooling loss through air leakage; loss of effective R-value due to wetting of thermal insulation by moisture transported through air currents; and loss of effective R-value due to convective loops, also known as the wind-washing effect.

In addition to their primary function, air barriers can protect against water intrusion, in which case they are *air and water resistive barriers*. Some air barriers also control vapor diffusion, in which case they are *air and vapor barriers*. *Air, water and vapor barriers* play a critical role in managing air and moisture movement through the building enclosure. "Unfortunately, there is still confusion on the functionality associated with different barrier membranes, especially when a single membrane performs multiple functions," says Spinu, noting that the most common confusion is between air barrier and vapor barrier functions. "While air barriers can and should be used in all climates, *vapor barriers* are climate specific," she adds.

AIR BARRIER PERFORMANCE REQUIREMENTS

There are four main performance requirements for air barriers: air infiltration resistance, continuity, structural integrity, and durability.

Air infiltration resistance: An air barrier must resist airflow. While there are no mandatory requirements at the national level, individual states have adopted energy conservation codes that require air tightness and allow for different compliance options for air infiltration resistance of air barrier materials, assemblies, or whole buildings (as previously described).

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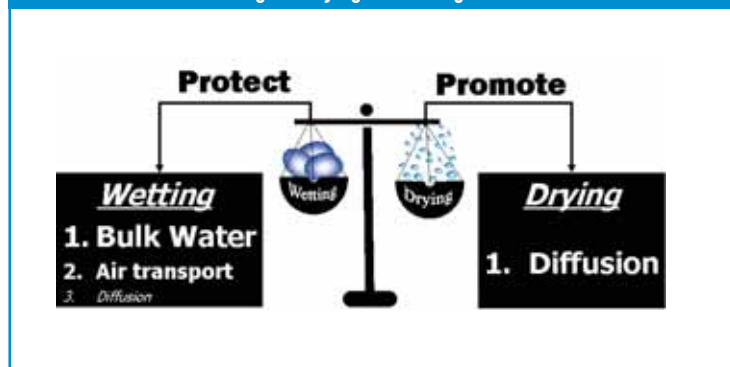
Continuity is a critical requirement for air barriers, and depends on both design and execution. The first step is to detail the air barrier continuity in the drawings. "A continuous line of air tightness must be traced through every exterior wall detail, and every connection between air barrier components," says Spinu. The most critical connections include: the roof and wall; wall and foundation; wall and floors; wall and window or door interfaces; joints between various types of exterior wall systems, and penetration details. The design details must then be properly implemented in the field. The air barrier system includes the primary air barrier membranes and the installation and continuity accessories, such as mechanical fasteners, tapes, flashing, caulks, sealants, and primers.

Structural integrity is another attribute of an effective air barrier. Air barriers must be able to withstand pressure loads or be able to transfer the load to other elements of the building envelope without rupture or displacement. For mechanically fastened building wraps, the type of mechanical fasteners and their spacing are important for structural integrity, and the installation must be done according to the manufacturer's instructions.

Finally, air barriers must be *durable*. They must be able to withstand environmental exposure, including exposure to ultraviolet (UV) rays, thermal cycles, and mechanical pressure. These requirements extend from the construction cycle through the service life of the enclosure. If that life-cycle requirement can't be met, then an air barrier must be accessible for periodic maintenance.

In addition to these basic requirements, an air barrier membrane should also balance the *critical barrier* properties for optimum moisture management: air infiltration resistance, water resistance, and vapor permeability. The air barrier membrane should combine high resistance to water penetration and air infiltration (to protect against bulk water intrusion and moisture transported by air currents, respectively), with optimum moisture vapor permeability to allow drying from incidental moisture. The balance of properties is generally difficult to achieve, because the three barrier properties have competing demands. Consequently, only few materials achieve this optimum balance, while most excel in one or two categories.

Wetting vs. Drying of Building Enclosure



The multiple consequences of uncontrolled airflow may result in potential liability issues for the entire building community. Architects, consultants, and engineers could be held liable for moisture damage in buildings because of faulty design or poor material selection. Contractors' workmanship can be called into question when water damage is due to poor execution of the intended design or unauthorized material substitution. Building owners may be held responsible for poor indoor air quality, mold problems or lack of thermal comfort. With serious consequences for the design and building industry professionals, building owners and building users, it behooves all members of the building team to pay close attention to controlling unwanted air flow and selecting the proper barrier method.

SELECTING APPROPRIATE AIR BARRIERS

There are many types of commercial air barrier membranes. Based on the method of application, there are three main types of air barriers: mechanically fastened (building wraps); peel-and-stick or self-adhered; and fluid applied. Based on vapor permeability, air barrier materials are vapor permeable and vapor non-permeable. Mechanically fastened membranes are vapor permeable; some fluid applied membranes have limited vapor permeability; all others are vapor non-permeable. While the application method is often a personal preference, the vapor permeability of air barrier membranes has performance implications, which must be considered when selecting an air barrier. As a general rule, vapor permeable air barriers can and should be used in all climates, while vapor non-permeable air barriers (air and vapor barriers) are climate specific. ■

CLICK FOR ADDITIONAL REQUIRED READING

The article continues online at <http://archrecord.construction.com/resources/conteduc/archives/0601duponttyvek-1.asp>. To receive AIA/CES credit, you are required to read this additional text. The quiz questions below include information from this online reading. To receive a faxed copy of the material, call DuPont™ Tyvek®: 1-800-448-9835, Prompt #1 or E-mail: tyvek.construction@usa.dupont.com.

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LEARNING OBJECTIVES

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- Understand the physics of air and moisture movement through the building enclosure.
- Discuss air barrier functions, benefits and performance requirements.
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INSTRUCTIONS

Refer to the learning objectives above. Complete the questions below. Go to the self report form on page 224. Follow the reporting instructions, answer the test questions, and submit the form. Or use the Continuing Education self report form on *Record's* web site—archrecord.construction.com—to receive one AIA/CES Learning Unit including one hour of health safety welfare credit.

QUESTIONS

1. The driving force for air leakage is:
 - a. The difference in total air pressure across a building assembly, with airflow occurring from positive to negative pressure.
 - b. The difference in total air pressure across a building assembly, with airflow occurring from negative to positive pressure.
 - c. Stack Pressure
 - d. Leaky materials in the building envelope
2. What is the driving force for vapor diffusion:
 - a. The difference in the total air pressure between the interior and exterior of the building.
 - b. The difference in water vapor concentration or difference in vapor pressure across an assembly.
 - c. The difference in atmospheric pressure at the top and bottom of a building due to difference in temperature.
 - d. Water intrusion into a building
3. What is the largest wetting source for above grade walls:
 - a. Air transported moisture
 - b. Vapor diffusion
 - c. Liquid or bulk water infiltration
 - d. Uncontrolled air flow
4. What is the primary function of an air barrier?
 - a. Water resistance
 - b. Vapor resistance
 - c. To prevent air leaking through porous materials
 - d. To control air leakage
5. An additional air barrier function is:
 - a. Controlling air flow
 - b. Protecting water intrusion
 - c. Preventing mold growth
 - d. Eliminating pollutants
6. Air barrier requirements include:
 - a. Ability to withstand pressure loads or be able to transfer the load
 - b. Durability
 - c. Continuity
 - d. All of the above
7. An effective air barrier should have:
 - a. High resistance to liquid water penetration
 - b. High resistance to air infiltration
 - c. Optimum moisture vapor permeability
 - d. A balance of critical properties
8. A key consideration when selecting an air barrier system for a building enclosure is:
 - a. Vapor transmission
 - b. Climate
 - c. Sustainability
 - d. Site design
9. What type of air barrier can and should be used in all climates and all wall designs?
 - a. Vapor non-permeable
 - b. Vapor permeable
 - c. Mechanically fastened
 - d. Self-adhered
10. Vapor non-permeable air barriers must be located:
 - a. On the cold side of the thermal insulation
 - b. On the warm side of the thermal insulation
 - c. Anywhere in the wall assembly
 - d. None of the above



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SELECTING APPROPRIATE AIR BARRIERS

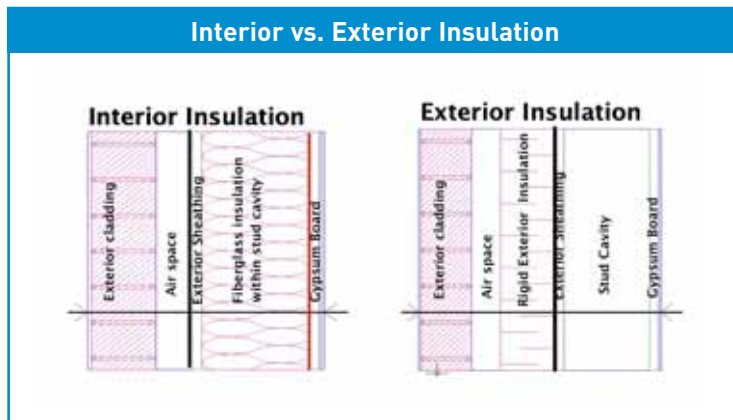
There are many types of commercial air barrier membranes. Based on the method of application, there are three main types of air barriers: mechanically fastened (building wraps); peel-and-stick or self-adhered; and fluid applied. Based on vapor permeability, air barrier materials are vapor permeable and vapor non-permeable. Mechanically fastened membranes are vapor permeable; some fluid applied membranes have limited vapor permeability; all others are vapor non-permeable. While the application method is often a personal preference, the vapor permeability of air barrier membranes has performance implications, which must be considered when selecting an air barrier. As a general rule, vapor permeable air barriers can and should be used in all climates, while vapor non-permeable air barriers (air and vapor barriers) are climate specific.

Architects note that installation is key, especially in residential applications. The energy benefit of the house wrap is to minimize air infiltration along sheathing joints and into framing cavities. Literally unfolding the roll around the house in a full nine-foot length provides a seamless wrap that then has door and window openings cut into it. "I get frustrated by contractors who insist on cutting up the membrane into small pieces. This not only defeats the purpose, it creates the opportunity for air and moisture infiltration at each seam," says Arseneault, who has been involved in energy efficient-housing since 1980. "Even if it is seamed properly with 18-inch overlaps and seaming tape as the manufacturer suggests, that approach is more costly and still prone to installation errors. This is a sophisticated product that warrants proper installation and attention to detail to be effective and avoid unnecessary problems."

When selecting an air barrier it is important to understand how it will perform in each system and under specific environmental conditions. While the air barrier must protect against air leakage, it should also enhance the ability of wall assemblies to manage incidental moisture intrusion. There are two key considerations to keep in mind when selecting an air barrier system for a building enclosure: wall assembly design, and climate type.

Wall Assembly Design

There are basically two types of wall assembly designs, based on the location of thermal insulation within the wall assembly.



The interior insulation wall design has the thermal insulation within the wall cavity, that is, the batt insulation within the stud cavity. In the exterior insulation design, the thermal insulation is placed outside the wall cavity, with rigid insulation outside of the exterior sheathing. The exterior insulation wall, which is more commonly used in cold climates, provides two main advantages: it eliminates the thermal bridging (which is significant in steel stud construction) and it moves the dew point outside the interior wall cavity, thus avoiding condensation within the interior wall. A combination wall design includes both batt insulation and rigid exterior insulation.

Climate type

Climate is a very important design factor when considering air barrier selection. While the building physics principles are universal, they must be applied to local environmental

conditions, which are climate specific. North America has eight climate zones that could be considered as the intersection of the three major climate types, dry, humid, and marine, with eight thermal bands that progress northward from very hot to very cold.

Many condensation and moisture problems may be the result of importing building practices from one climate to another, without considering the consequences of the local climates, such as changes in moisture loads and vapor pressure drive. Building practices must address climate-specific loadings on the building enclosure. An extensive discussion on the climate specific design is beyond the scope of this article. However, the wall assembly design and climate type affect the choice of air barrier.

Additional Application Methods

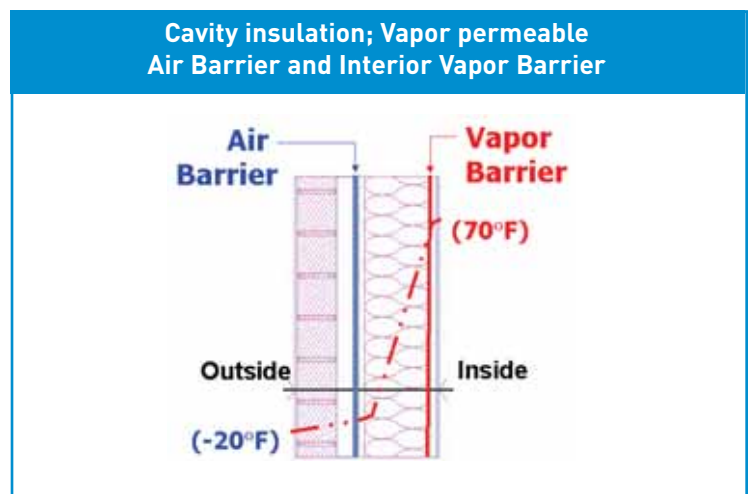
In addition to the three main types of air barriers previously noted, other application methods include Sprayed Polyurethane Foams (SPF) and torch-applied membranes. The choice of air barriers based on the application method is often a personal or regional preference, which takes into account the ease of application on certain back-up walls, the material availability and cost, the familiarity of the designer, specifier or contractor with certain products and manufacturers, and access to certified installers.

Vapor Permeable Versus Vapor Non-Permeable Air Barriers

Based on vapor permeability, air barrier materials are classified into vapor permeable and vapor non-permeable. The vapor permeability of building materials has implications on the ability of the building enclosure to manage the moisture loadings: vapor permeable materials allow diffusion, while vapor non-permeable materials do not allow diffusion. Although moisture movement by diffusion cannot be discounted as a wetting source, diffusion is much more critical as a drying mechanism. This is true of all building materials. Mechanically fastened membranes are vapor permeable; some fluid applied membranes have limited vapor permeability; all others are vapor non-permeable. The vapor permeability will dictate the air barrier placement in the building assembly: vapor permeable air barriers can be placed anywhere in the assembly, while vapor non-permeable air barriers must generally be installed on the warm side of the assembly, in order to avoid condensation.

Cold Climate Case Studies

To understand how the wall assembly design and climate affect the selection of an air barrier, consider a cold climate example, in Minneapolis, Minnesota, with a traditional cavity insulation wall design. The air barrier for these walls is typically installed on the exterior face of the exterior sheathing. The next figure describes how a vapor permeable air barrier works in this assembly for this climate.

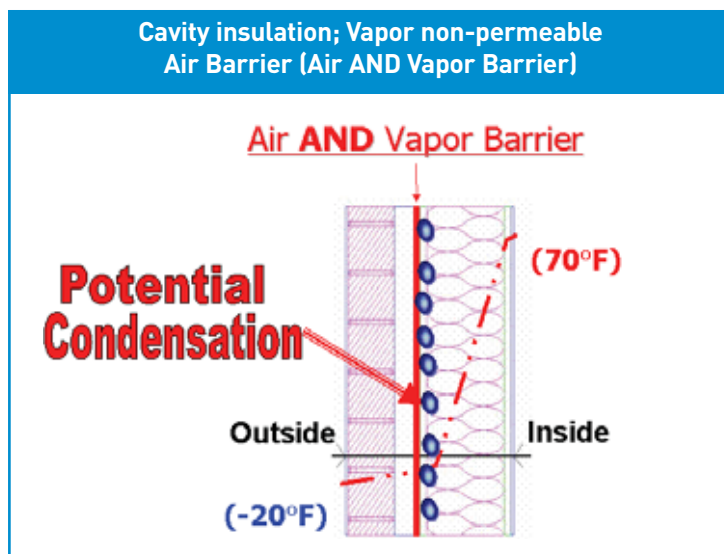


The exterior air barrier will protect the wall cavity against liquid water intrusion and air infiltration, but will allow drying from incidental moisture to the outside.

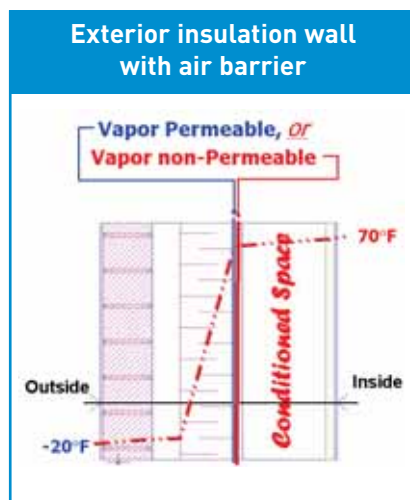
In this climate, the predominant driving force for vapor diffusion, hence the preferred drying direction, is from the inside to the outside. In addition, a vapor barrier on the interior side

of the wall cavity would protect against moisture vapor diffusion from the inside. Here, the inside air is predominantly warmer and wetter than the outside air. This cold climate example shows that the use of an exterior vapor permeable air barrier, in conjunction with an interior vapor barrier, is a good practice.

A vapor non-permeable air barrier installed on the exterior face of the exterior sheathing would perform differently with this wall assembly, in this climate. The vapor non-permeable air barrier combines the functions of air barrier and vapor barrier into a single membrane. The membrane will protect the wall cavity against liquid water intrusion and air infiltration; however, because the membrane is vapor non-permeable (vapor barrier), it will not allow drying from incidental moisture to the outside, because in this climate the predominant driving force for vapor diffusion is from the inside to the outside. In addition, the vapor barrier would be located on the cold side of the insulation, leading to potential condensation. This example shows why vapor non-permeable air barriers (air and vapor barriers) should not be used in this climate with the interior insulation wall assembly.



Another example would be an exterior insulation wall assembly, located in the same climate. An important characteristic for this type of wall design is that the wall cavity is considered part of the conditioned interior space, therefore it relies on HVAC, and not on vapor diffusion, for removal of incidental moisture. The air barrier in this assembly is typically sandwiched between the rigid insulation and the exterior sheathing. Therefore, it would be located on the warm side of the insulation. As a result, this assembly design could use either vapor permeable or vapor non-permeable air barrier membranes.

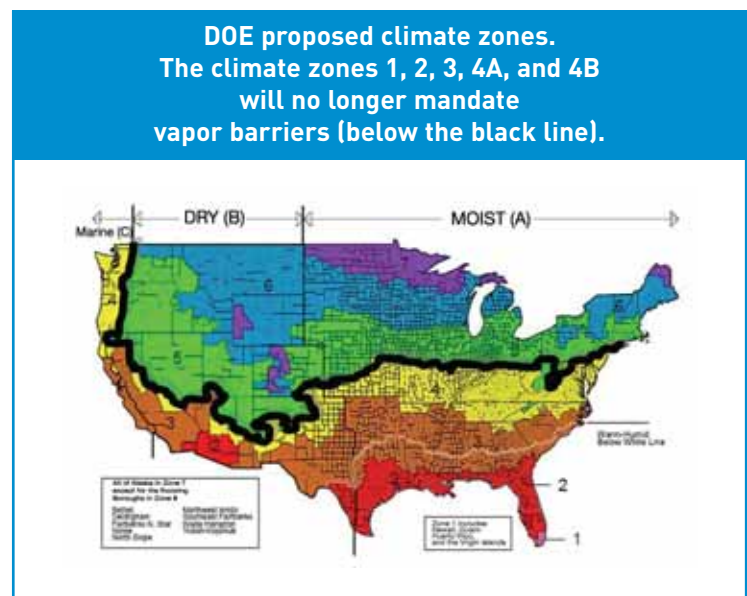


BEST PRACTICES

The previous examples are in cold climates; however, a similar analysis must be performed for other climates. A common mistake is importing building practices from one climate to another, without a fundamental understanding of building physics.

For example, vapor barriers have been introduced in Canada to prevent interior moisture from migrating into the wall assembly. "While this is a good practice for cold climates where the inside air is warmer and wetter than the outside, the use of vapor barriers in mixed or hot and humid climates has probably contributed to moisture problems in recent years," says Spinu, noting that this is further aggravated by the practice of using vinyl wall paper as an interior finish in these climates. Such practices often lead to double vapor barriers. "Fundamental physics must be understood in order to avoid moisture problems. Vapor barrier use in mixed or hot and humid climates has been challenged, and the codes are being reviewed," Spinu adds.

The 2006 IBC code will delete section 1403.3 from the 2003 IBC version (on Vapor Retarders). The vapor retarder requirements will be referenced to the IECC code (International Energy Conservation Code). The major change is that vapor barriers will no longer be required in certain constructions, for climate zones 1, 2, 3, 4A, and 4B.



An extended discussion of all climate zones is beyond the scope of this article. However, as a general rule, vapor permeable air barriers can and should be used in all climates and all wall designs. Vapor non-permeable air barriers, which are air and vapor barriers, must be located on the warm side of the thermal insulation, and their use should be climate specific.