THE ULTIMATE GUIDE TO

Commercial Air & Water-Resistive Barriers

Commercial Air and Water-Resistive Barriers Overview

Continuity of air and water management from roof systems, vertical walls, and waterproofing terminations is critical for commercial buildings to achieve durable designs, energy-efficient performance, and to enable occupant health and comfort as part of holistic design solutions. The building enclosure serves to protect the structure, as well as interiors, from air and water intrusion resulting from rain, snow, wind and other phenomena of seasonal and regional weather. Professionally installed, continuous air and water-resistive barrier systems are engineered to minimize unwanted air and water intrusion in the building enclosure, in order to provide the structure with several significant benefits. An air and water-resistive barrier system provides a critical defense for controlling bulk water and air leakage.

Siplast® created this guide to help commercial architects, consultants, specifiers, contractors, and members of the building design community achieve a better understanding of key performance factors to consider when selecting and installing a commercial air and water-resistive barrier system. It addresses the critical importance of how this system integrates with other relevant components and systems to help prevent unwanted air infiltration, exfiltration, and intrusion through the building enclosure. The guide also provides a general overview for designing and installing an effective air and water-resistive barrier system with code compliance in mind.

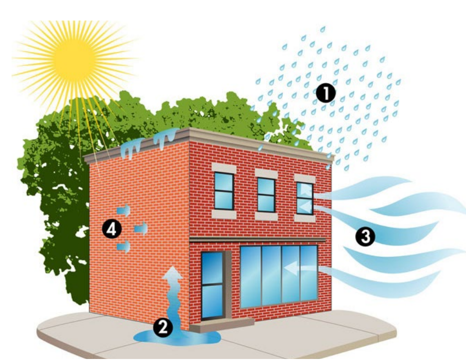
Air Barrier Basics: What is an Air Barrier?

A continuous air barrier system is a combination of interconnected materials, assemblies, sealed joints, and components of the building enclosure that minimize air leakage into or out of the building enclosure. Controlling the movement of air through the building enclosure can minimize the moisture carried and deposited by the air leakage. Air leakage can move inward (infiltration) or outward (exfiltration) through the building enclosure.

Pressure differences across the building enclosure are the principal force for air movement in either direction and are created by factors such as wind, inside and outside temperature differences, stack effect, and an imbalance between supply and exhaust air systems.

The air barrier system design and assembly, in relation to the building enclosure components, should address all forms of air movement, including:

- **Infiltration** – unconditioned, outside air flowing into the conditioned indoor spaces of a building
- **Exfiltration** – conditioned inside air flowing to the outside of the building
- **Intrusion** – intrusion occurs when conditioned air moves from the conditioned spaces of a building into the wall or roofing system, the air movement potentially bypassing insulation, which can lead to condensation and the



damaging effects of mold. Technically, this is not considered air leakage, but rather unintentional air movement, as once the air enters the assembly, it loops back and re-enters the conditioned space, potentially having deposited moisture and changing temperature.

SCHEDULE A MEETING WITH A REP

Ultimately, a high-performing air barrier system should:

- Meet permeability requirements of the structure
- Be installed continuously over the entire building enclosure
- Withstand forces and anticipated building movements, such a wind, stack effect, and mechanical ventilation
- Be compatible with other related wall and roof component systems
- Maintain its integrity and durability over the designed timeframe

Permeable vs. Impermeable Air Barriers

Air barriers, whether permeable or impermeable, play a critical role in maintaining the integrity of the building enclosure. They serve as a key line of defense against air leakage and bulk water infiltration, to help ensure the structure is energy efficient and comfortable for its occupants.

Permeable Air Barriers

Permeable air barriers are known for their ability to resist the passage of air and bulk water while permitting the diffusion of water vapor through the material.

This feature is particularly beneficial as it allows incidental moisture that has found its way into the assembly to dissipate slowly, which helps to mitigate risks of mold growth or structural degradation due to prolonged exposure to dampness. The ability to stop air and water, while allowing for incidental drying, makes permeable air barriers a flexible and favored choice among design professionals for numerous wall assemblies.

Impermeable Air Barriers

Impermeable air barriers, like their permeable counterparts, block air and bulk water. However, they allow virtually no passage of water vapor, or drying through the material as a result. Impermeable air barriers require careful design and integration with adjoining building components, such as in conjunction with the exterior continuous insulation in the wall assembly.

The entire wall assembly that utilizes an impermeable air barrier must be designed to both resist condensation from air leakage and air intrusion, as well as permit drying to prevent incidental moisture accumulation. This can be especially beneficial when wall systems are carefully designed for certain climate conditions and for specific building uses where the risk of internal moisture build-up is minimal, but external water resistance is paramount.

Choosing between these two barrier types is not a one-size-fits-all scenario. In fact, it requires a careful examination of the building's location, its intended use, and its exposure to certain weather conditions. For instance, a commercial building located in a humid climate may require a vapor-permeable air barrier to allow moisture trapped within the walls to escape in order to prevent damage. Conversely, a building wall design with primarily continuous exterior insulation may be better suited to an impermeable barrier behind the insulation.

Testing for Airtightness

Proper management of air and vapor in building construction can enhance the longevity of a building, improve indoor air quality, and reduce operating costs by ensuring greater energy efficiency. Building codes increasingly require higher standards for air tightness.

Green building standards, such as USGBC LEED, are structured to maximize levels of airtightness and encourage construction to the highest possible standards. Third-party evaluation for air tightness of materials and assemblies, such as ABAA Evaluation, provides the evidence-based resources necessary to help architects choose products during the design phase that contribute to a whole building system that will meet these standards. The ABAA Evaluation combines the requirements of air barrier material and assembly testing, including energy code requirements and additional material type-specific criteria.

Material Testing

A material qualifies as an air barrier using the ASTM E2178 test. An air barrier material has an air leakage rate no greater than 0.02 L/(s·m²) at a pressure difference of 75 Pa (0.004 cfm/ft² at a pressure difference of 1.57 lb/ft²) when tested in accordance with ASTM E2178.

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Assembly Testing

The energy code mandates that assemblies within a continuous air barrier of an opaque building envelope achieve an average air leakage rate of no more than 0.04 cfm/ft2 (0.2 L/s•m2) under a pressure 1.57 lb/ft2), when tested primarily in accordance with ASTM E2357.

Whole Building Testing

Measuring whole building air leakage with a blower door test allows designers to assess a building's performance by verifying the airtightness of the building enclosure.

What is a Blower Door Test

A blower door test measures air leakage rates through a building enclosure under controlled pressurization and depressurization. The test is conducted by an energy professional and is performed according to the following protocol:

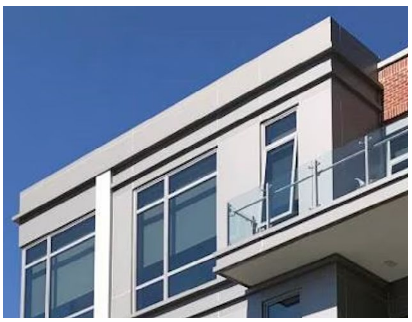
- During design, a testing plan is created, communicated, and performance expectations are set.
- The building is prepared for testing by securing all openings, ensuring windows and doors are closed, and turning off all HVAC systems and ventilation fans.
- The fan or series of fans are mounted and calibrated (blower door) into the frame of an exterior doorway.
- The fan pulls create a pressure difference between the interior of the structure and the outside air pressure. The difference in air pressure creates air leakage flows through all unsealed cracks, gaps, and openings, such as wiring penetrations.
- A manometer measures the air moving through the fan in cubic feet per minute at each pressure setting to determine the amount of air needed to replace the leaking air and maintain a constant pressure difference from inside to outside.
- Using the measured air leakage rate and the building's six-sided enclosure surface to determine square footage, they can calculate the ASHRAE 90.1 2022 air leakage target value as 0.35 cfm/sf at a pressure difference of 75pa. A reprint of the full article is available here.

What is a Water-Resistive Barrier?

The water control layer of a building enclosure includes cladding, which protects the structure from the outside against bulk water, and a code-specific, water-resistive barrier. The water-resistive barrier is positioned in the assembly between the exterior cladding and the exterior sheathing and manages water within the building enclosure.

The barrier resists water that leaks, penetrates, or seeps past the exterior cladding, and provides a space for moisture evaporation, along with a protective mechanism to prevent moisture from infiltrating to the building interior. When properly installed, the water-resistive barrier is integrated with flashing and system accessories in a shingle-lap fashion to direct water away from the structure and manage water within the building envelope.

The proper performance of water-resistive barriers depends on the correct, continuous configuration of details, particularly at interfaces such as those between the roofing and walls.



The role of the water-resistive barrier, in order of importance, is to:

During design, a testing plan is created, communicated, and performance expectations are set.

The building is prepared for testing by securing all openings, ensuring windows and doors are closed, and turning off all HVAC systems and ventilation fans.

Controlling water at the wall-roof interface requires:

- Continuous and properly lapped coping over the roof and walls to keep bulk water from seeping into the building enclosure
- Correctly lapped secondary barriers (water and air) that form a continuous barrier under the coping designed to shed water, to further protect the building enclosure if coping joints fail and allow water infiltration
- Drip edges to remove the drained water away from the structure

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Performance Testing of Water Control Layers - Testing for Water Tightness

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Material Testing

Manufacturers use AATCC 127, ICC-ES AC 38 (sheet materials) and AC 212 to evaluate materials for water resistance. However, assembly testing is required to ensure that the interfaces between the various layers provide water resistance.

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Assembly Testing

Assembly tests for certifying water resistance include ASTM E331, AC 38, and AC 212. Finally, to ensure that the building will perform as intended by the designer, builders can use in situ testing (ASTM E1105 5.1 – 5.7, AAMA 501.1, and 501.2) to confirm the whole building's water-resistance performance meets the requirements for the project.

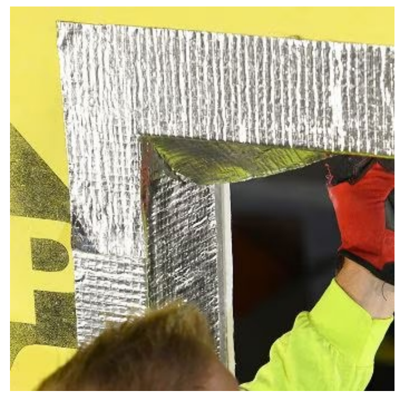
Air and Water-Resistive Barrier Systems?

Professionally installed continuous air and water-resistive barrier (AWB) systems minimize unwanted air and water movement through the building enclosure. A high-quality AWB will also maintain its integrity and remain stable when exposed to high heat and UV rays, while offering excellent tensile strength, elongation, and tear resistance, which is critical to maintaining the continuous protection properties of an AWB.

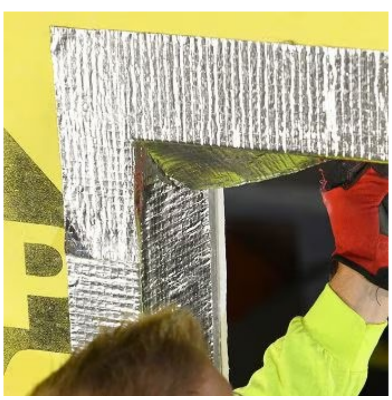
Benefits of a High-Performance AWB Include:

Managing incidental moisture in wall systems to reduce the potential for mold in the wall cavity, which protects the structure's integrity

Limiting the loss of conditioned air (heating and cooling), to help ensure a more comfortable indoor environment



Facilitating lower energy use within the structure, which reduces operating costs while also reducing carbon emissions



Increasing air tightness, which when combined with a well-designed ventilation system, provides a healthier indoor environment by maintaining consistent humidity and temperature, which results in decreased potential for indoor mold growth

Lowering the initial investment in operating systems, such as HVAC, which often can be accomplished with an airtight building design

Designing a Successful Air and Water-Resistive System

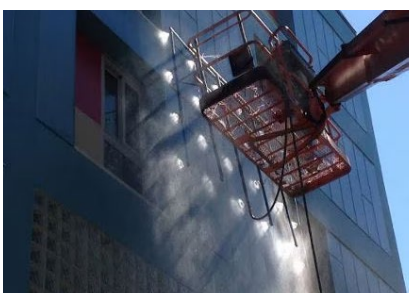
An air and water-resistive system includes several building enclosure components. The success of the air and water barrier system depends on the input of the entire project team in the overall system design and execution. Specifying and installing air and water-resistive barrier membranes and accessories from a single manufacturer can improve continuity between materials and assemblies, limit supply chain issues, and allow for single-source warranties.

Tips for best practices when designing a continuous air and water-resistant barrier include:

Engage an air barrier specialist to review construction drawings and specifications during the design phase of the project to support the design vision and reduce the risk of errors or omissions concerning the air and water barrier system.

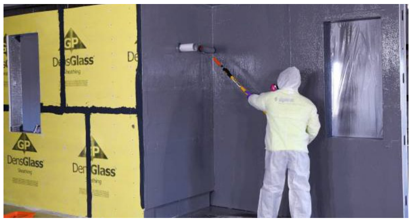
SCHEDULE A MEETING WITH A REP

When combined with quality exterior continuous insulation the design and attachment of the insulation should support the optimum performance of the air and water barrier.



If a vapor barrier is required by code, incorporate a vapor control layer in the design in a manner that facilitates drying in at least one direction of the wall assembly and in conjunction with an air barrier that prevents condensation that can result from air leakage and potential re-entrant air intrusion.

Construct mockups (freestanding mock wall assemblies) that include the exterior wall substrate, air and water-resistive barrier system, with cladding, insulation, and fenestration installed to verify air tightness.



Conduct water and air leakage testing, identify deficiencies, and make repairs as needed to the air and water-resistant barrier systems before the final installation of cladding.

Types of Air and Water-Resistive Barriers

Manufacturers of commercial air and water-resistive barriers typically offer two core material types: self-adhered sheets or fluid-applied membranes. Both of these membrane types have significant advantages over mechanically attached membranes. It is not uncommon to use both types of membranes on the same project to employ their unique advantages. For instance, self-adhered sheet membranes are often applied to long, opaque sections of a wall assembly, while fluid-applied membranes are ideal for the more difficult-to-cover areas such as curved surfaces, openings or corners, including areas of the building with complex geometries.

Choosing the right air and water barrier for the project depends on the budget, material costs, and the installer's skills and familiarity with the product. The type of air and water-resistive barrier membrane specified and installed on a structure also must meet the designer's and building owner's performance expectations and specifications.

Self-Adhered Air and Water-Resistive Barrier

Self-adhered air and water-resistive barriers create a monolithic, waterproof, airtight layer when properly installed. These membrane types typically come in rolls and are composed of an engineered top sheet on the exterior side and an adhesive with release film underneath. Ideally, the self-adhered membrane utilizes a butyl adhesive for ultimate adhesion and temperature-stable performance properties. To properly install barriers over sheathing material, self-adhered air and water barriers may require a primer to obtain optimum adhesion.

Advantages of Self-Adhered Sheet Air Barriers

- Some top sheets are engineered to be highly heat-stable
- Accepts a wide range of adhesives and sealants
- Durable enough to withstand the rigors of the construction process
- Manufacturer-controlled membrane thickness
- No mixing or special installation equipment needed
- Bridges gaps easily without additional detailing
- Allows for application in temperatures down to 20º F (-6.6C)
- No VOC's

Fluid-Applied Air and Water-Resistive Barriers

Fluid-applied AWBs provide seamless, monolithic durable membranes that are fully adhered to the exterior sheathing without fasteners or priming. Installers can apply the membrane in one of three ways: spray, roll, or trowel the air barrier to the substrate. Fluid-applied AWB technologies include water-based acrylics and emulsions, solvent-based asphaltic, and moisture-cured silicone, such as STPE.

Advantages of Self-Adhered Sheet Air Barriers

- Provides a seamless, monolithic, durable membrane
- Excellent for complex geometries and rough surfaces
- Easily seals around penetrations
- High-solids STPE moisture-cure technology:
    - Relatively quick cure time vs other technology fluid-applied air barriers
    - Resists wash-off from rain, post application
    - Maintains the original application thickness when cured
    - Improves onsite installation reliability

Choosing the Right Air and Water Resistive Barrier System

When selecting the best air and water-resistive barrier system for each project, the climate zone, wall assembly design, building type, building purpose, and interior climate, along with building details and penetrations need to be considered.

Climate Zone Influence on Choice of Air and Water-Resistive Barrier System

The climate zone must be considered when designing the air and water barrier system. Climate conditions directly impact moisture control and energy efficiency, and each climate zone presents unique challenges to building enclosure design, including air and water-resistive barrier performance. The parameters to consider in each climate region include average temperature, precipitation, and heating degree days.

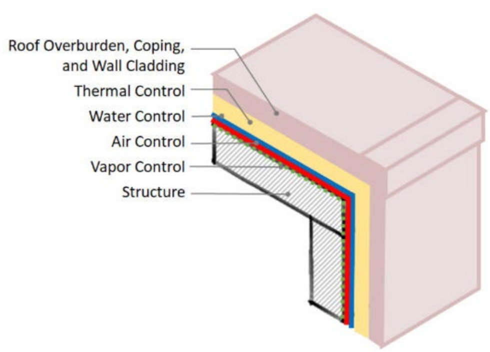
Consider Wall Assembly Design

Selecting the right air and water-resistive barrier materials can help to ensure moisture control and maximize the overall performance of an air and water-resistive barrier system, regardless of climate. These are important components of the wall assembly that must be considered during the design process. Factors that influence the choice of materials used in an air and water-resistive barrier system include:

- The building enclosure construction and substrate type
- The building enclosure finishes, including the method of attachment or adhesion of the cladding
- Compliance with building code requirements such as NFPA 285

Understand Building Type, Purpose, and Interior Climate

The air and water-resistive barrier system impacts the building's ability to ensure occupant comfort (temperature and relative humidity), as well as building energy efficiency. The Achieving Airtight Buildings Illustrated Guide states "An airtight building enclosure, coupled with a well-designed mechanical ventilation system, can offer a high-performance solution that improves durability, reduces heat loss, and improves air quality." The intended use of the building should factor into the material selections being considered for the building design in order to meet the needs and comfort of the building's occupants.



Assess Building Details and Penetrations

Integrating the air and water-resistive barrier system with the building components to create a continuous air and water barrier requires evaluating the building's details and penetrations:

- Roof-to-wall transitions
- Door, window, curtain wall, and storefront openings
- Wall-to-foundation transitions
- Expansion joints
- Transitions between dissimilar enclosure systems
- Transitions between dissimilar materials
- Plumbing, mechanical, electrical, and structural penetrations
- Floors over unconditioned space
- Canopies, overhangs, and exterior vestibules
- Walls between conditioned and unconditioned spaces

Building Codes

When designing, constructing, or renovating a building, architects, specifiers, consultants and contractors must comply with building codes, which address safety, structural stability, and energy efficiency requirements.

Local building codes have been changing rapidly to address changes in building technologies, the consequences of weather events, and to improve the energy efficiency of buildings. Contacting building authorities or zoning boards early in the design phase can help to ensure that the most updated codes are considered in the building design. Plans can be submitted to the city or county's municipal office to verify that the most recent version of local codes have been applied.

Future-Proofing the Design

Most building design professionals consider, from an investment standpoint, designing and building beyond code requirements. Anticipating materials, technology, and systems that can extend the viability and usability of a building helps to reduce demands on natural resources. Studies show a link between climate change and increasing temperatures and precipitation – a situation that will continue, but that can be addressed by enhancing the energy efficiency and long-term performance features of buildings designed today.

Code Requirement Overview

- The International Building Code (IBC) offers a model code with minimum requirements for safeguarding public health, safety, and general welfare.
- The International Energy Conservation Code (IECC-2021) and the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE Standard 90.1-2022) Standards provide building and design professionals with two options for the new energy codes.
- The American Society of Civil Engineers, ASCE 7 engineering code provides a set of minimum requirements for the building's structural resistance.

Energy Efficiency (IECC, ASHRAE 90.1)

Thermal	(IECC C402 and ASHRAE 90.1 Chapter 5)
Air Barrier	(IECC C402.5 and ASHRAE 90.1-5.4.3.1)

Exterior Walls (Chapter 14 IBC)

Weather Protection	(IBC 1402.2)
Vapor Retarders	(IBC 1404.3)
Flashings	(IBC 1404.4)

Roof Assemblies (Chapter 15 IBC)

Weather Protection	(IBC 1503)
Requirements for Roof Coverings	(IBC 1507)
Flashings	(IBC 1503.2)
Copings	(IBC 1503.3)
Wind Resistance	(IBC 1504.1 and ASCE 7)
Edge Securement	(IBC 1504.5 and ANSI/SPRI ES-1)

Fire Code Requirements

In Type I, II, III and IV buildings, the air, water and thermal control layers must simultaneously meet material fire requirements, such as ASTM E84, Class A, and assembly fire requirements, including NFPA 285 compliance with combustible components in the wall assembly insulation, cladding, or AWB. Manufacturers can demonstrate compliance with NFPA 285 requirements with project-specific testing results or engineering evaluations based on performing and passing full-scale assembly and material analysis results. Type V buildings, considered combustible buildings, do not need to meet these requirements.

Why Siplast Air & Water Resistive Barriers?

Siplast delivers high-performance building enclosure solutions and unparalleled levels of service and partnership, setting industry standards for the future of building design and construction. To learn more about Siplast and the brand's high-performance WALLcontrol™ product line, visit siplast.com.

What Makes Siplast WALLcontrol Air and Water Resistive Barriers the AWB of choice?

Siplast WALLcontrol AWB systems provide high-performance solutions for vertical walls to create a continuous air and water-resistive barrier for commercial buildings and enable complex transitions from roofing and waterproofing systems.

- Siplast air and water-resistive barrier systems are compatible with other Siplast systems, including roofing and waterproofing systems. Door, window, curtain wall, and storefront openings
- Siplast products are evaluated for high-temperature performance, which is particularly vital at the roof and wall interface.
- To accommodate the wall areas of new and retrofit building enclosures, Siplast offers consultant-grade air and water barrier products, including roof, fenestration flashings, wall membranes, etc.
- Siplast offers a line of high-performing, moisture-cure liquid air barrier products with high solids content and high elongation. The moisture curing process reacts with moisture in the air to cure after application, to limit shrinking, pin-holing, and to resist washing off the substrate.
- The Siplast complete building enclosure solution for an air and water-resistive barrier system, along with Siplast roofing and waterproofing systems, comes with a comprehensive warranty.

Would you like to discuss your next project with a WALLcontrol Advisor?

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