TECHNICAL BULLETIN SERIES

Why Vapor-Permeable Air Barriers Are Often the Better Choice in Climate Zone 4

Improving drying capacity, moisture resilience, and long-term wall durability in mixed climates

APPLICATION Above-grade exterior wall assemblies	**AUDIENCE** Architects, consultants, contractors, and owners
CLIMATE IECC Zone 4A, 4B, & 4C	**ISSUE DATE** August 2026

KEY CONCLUSION For most conventional, above-grade framed walls in Climate Zone 4, a continuous vapor-permeable exterior air/water barrier is the more forgiving default because it controls airflow without unnecessarily blocking outward drying. It is not universally superior: the final selection must be coordinated with the full wall assembly, cladding, insulation, interior finishes, occupancy, and local code.

Purpose and scope

Climate Zone 4 is a mixed climate. Buildings experience meaningful heating-season vapor drive toward the exterior and, depending on location, occupancy, air-conditioning, rainfall, and solar exposure, cooling-season vapor drive toward the interior. Zone 4 includes moist (4A), dry (4B), and marine (4C) subzones. A wall that can safely manage both wetting and drying is generally more resilient than one that depends on never getting wet. [1]

This bulletin addresses above-grade wall air barriers. Roofs, below-grade waterproofing, cold storage, natatoriums, high-humidity industrial spaces, and other unusually severe occupancies require separate analysis.

Air control and vapor control are different

An air barrier limits the movement of air through the enclosure. A vapor retarder limits water-vapor diffusion through materials. These are independent properties: a membrane can be highly airtight and still allow vapor diffusion. Under the 2021 IECC commercial provisions, an air-barrier material may qualify at an air permeance no greater than 0.004 cfm/ft^2 at 75 Pa when tested to ASTM E2178. [2]

That distinction matters because air leakage can transport far more moisture into an assembly than diffusion. The first priority is therefore a continuous, well-detailed air-control layer. Once airflow is controlled, vapor permeance should be selected to provide the needed vapor control without eliminating useful drying capacity. [3]

Property	What it controls	Typical reporting
Air permeance	Airflow through the membrane itself	ASTM E2178; cfm/ft^2 at 75 Pa
Assembly leakage	Airflow through membrane, joints, transitions, and penetrations	ASTM E2357 or project testing
Vapor permeance	Water-vapor diffusion through the material	ASTM E96; report dry-cup/wet-cup procedure
Water resistance	Bulk rainwater passing through the membrane	Applicable WRB/water-resistance testing

Technical note: Vapor-retarder classes are typically expressed as Class I (⩽0.1 perm), Class II (>0.1 to ⩽1.0 perm), and Class III (>1.0 to ⩽10 perms). Materials above 10 perms are commonly described as vapor-open. Terminology varies; compare products using the same ASTM E96 procedure and tested thickness.

Why permeability is advantageous in Climate Zone 4

- **Seasonal drying flexibility.** A vapor-permeable exterior air barrier permits moisture within sheathing or framing to migrate outward when exterior conditions favor drying. This is valuable in Zone 4, where vapor-drive direction and drying conditions change during the year.
- **Reduced risk of trapped construction moisture.** Wood sheathing, framing, concrete, masonry, and gypsum can contain moisture when enclosed. A low-perm membrane can slow drying after the wall is closed, extending the time moisture-sensitive materials remain elevated.
- **Greater tolerance of incidental wetting.** Perfect walls do not exist. Water can enter through flashing defects, damaged membranes, sealant failures, or wet cladding. Permeability does not replace drainage, but it adds a secondary drying path after incidental wetting.
- **Lower double-vapor-barrier risk.** When low-perm materials occur on both sides of a moisture- sensitive layer, moisture can become trapped. DOE guidance warns that vapor retarders on both sides can magnify accumulation because the assembly cannot readily dry toward either side. [3]
- **Airtightness without a vapor lock.** A properly tested and detailed permeable membrane can deliver the same air-control objective as a low-perm membrane. The durability benefit comes from separating the air-control function from unnecessary vapor restriction.
- **Compatibility with vapor-open exterior insulation.** Mineral wool, glass-fiber boards, and other vapor-open insulation strategies retain their drying advantage only when adjacent control layers do not become the dominant vapor bottleneck.

Performance comparison

Design issue	Vapor-permeable air barrier	Vapor-impermeable air barrier
Air leakage control	Can meet code and project airtightness requirements when continuous and properly detailed.	Can meet the same requirements when continuous and properly detailed.
Outward drying	Preserves a drying path through the exterior control layer.	Substantially restricts outward vapor drying.
Incidental wetting	More forgiving when moisture reaches sheathing or framing.	More dependent on inward drying and defect-free water management.
Seasonal vapor reversal	Generally better accommodates changing vapor-drive direction.	Requires the assembly to be intentionally designed around a fixed vapor-control plane.
Reservoir cladding	Requires a drained/ventilated cavity and a permeance selected to limit solar-driven inward vapor.	Can throttle inward vapor drive, but may also block winter outward drying.
Best-fit use	Conventional framed walls, vapor-open CI, moisture-sensitive sheathing, and ordinary occupancies.	Walls with verified inward drying, sufficient exterior insulation, or specialized vapor-control needs.

Comparison assumes both products provide equivalent water resistance, adhesion, durability, and air-barrier continuity. Vapor permeance alone does not determine overall system performance.

Important design limits

DO NOT SPECIFY BY PERM RATING ALONE **The complete wall—not one membrane—determines moisture performance. Every material layer, the cladding cavity, insulation location, interior humidity, orientation, and climate exposure affect wetting and drying.**

- **Reservoir claddings need special attention.** Brick, stucco, and adhered masonry can store rainwater. Solar heating can drive that moisture inward. Use a drained and ventilated cavity where required, detail flashings and weeps, and avoid assuming that the highest available perm rating is always best.
- **Exterior low-perm insulation may govern.** Foil-faced polyisocyanurate, XPS, closed-cell spray foam, and some adhered membranes can dominate the assembly's vapor profile. A permeable air barrier cannot create an outward drying path through an adjacent vapor-closed layer.
- **Marine 4 is not identical to 4A or 4B.** Model-code vapor-retarder provisions treat Marine 4 differently from the rest of Zone 4 in some building types and code editions. Confirm the locally adopted code and the required interior vapor-control strategy. [6]
- **Special occupancies require analysis.** Pools, commercial kitchens, hospitals with humidification, museums, cold rooms, and process facilities may impose vapor pressures outside ordinary assumptions. Use project-specific hygrothermal analysis and mechanical-design criteria.

Recommended design and specification approach

For a conventional above-grade framed wall in Climate Zone 4, the design team should generally start with a vapor-permeable, continuously bonded or fully detailed exterior air/water barrier and then confirm the assembly as a whole. The submittal review should address all of the following:

- Air permeance at the installed thickness, including the applicable ASTM E2178 result and continuity details at joints, openings, penetrations, and transitions.
- Water-vapor permeance under the stated ASTM E96 procedure (dry cup, wet cup, or both); do not compare unlike test methods as if they were equivalent.
- Compatibility with sheathing, exterior insulation, flashings, sealants, transition membranes, primers, cladding attachments, and anticipated construction temperatures.
- A continuous drainage plane, properly integrated flashings, and a drainage/ventilation cavity appropriate to the cladding and exposure.
- A wall-section review confirming at least one practical drying direction for each moisture- sensitive layer.
- Hygrothermal analysis where the assembly includes reservoir cladding, low-perm layers on both sides, unusual interior humidity, thick insulation, mass masonry, or an atypical wall configuration.

Bottom line

In Climate Zone 4, vapor-permeable air barriers are often superior because they provide the air control needed for energy efficiency and condensation resistance while preserving outward drying capacity. That combination makes conventional wall assemblies more tolerant of construction moisture, small water-management defects, and seasonal changes in vapor drive. An impermeable air barrier can perform successfully, but it requires a more deliberate wall design with verified condensation control and a reliable inward drying path—or materials that are not moisture sensitive.

RECOMMENDED POSITION Use a vapor-permeable exterior air barrier as the default for conventional Zone 4 above-grade walls. Depart from that default only when the complete assembly, occupancy, and exposure demonstrate a clear need for low exterior vapor permeance.

References

[1] Pacific Northwest National Laboratory, Building America Solution Center - IECC Climate Zone Map.
[2] International Code Council - 2021 IECC, Commercial Energy Efficiency, Section C402.5, Air Leakage.
[3] U.S. Department of Energy, Building America - Managing the Drivers of Air Flow and Water Vapor Transport in Existing Single-Family Homes.
[4] U.S. Department of Energy, Building America - Water Management of Non-Insulating and Insulating Sheathings.
[5] U.S. Department of Energy / Building Science Corporation - Moisture Durability with Vapor-Permeable Insulating Sheathing.
[6] International Code Council - 2021 IRC, Section R702.7, Vapor Retarders.