TECHNICAL REPORT

VAPOR MANAGEMENT AND THE BENEFITS OF VENTED CLADDINGS

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VINYL SIDING INSTITUTE™

The U.S. Environmental Protection Agency* (EPA) surveyed 100 buildings in various climates and found that 85% suffered water damage. About 45% of it came from typical water leaks, such as broken pipes or improper flashing. The remaining 55% or more than half of the damages the EPA found while surveying these 100 buildings came by water-vapor infiltration through exterior walls.

The construction industry began to confront water vapor infiltration through exterior walls as energy codes started to emphasize stringent air-sealing requirements. Air sealing trapped water vapor in walls and diminished the one benefit of poorly insulated, drafty houses—the drying effect. Water vapor trapped within air-tight wall cavities rots structural sheathing, encourages microbial growth and may remain hidden from view until the conditions become severe. Unlike water leaks that produce localized evidence of their existence, vapor acts subtly. Dispersed throughout walls, over time, it may damage an entire elevation requiring extensive repair.

Part of the solution is the use of vented cladding.

The 2021 edition of the International Residential Code (IRC) addresses water vapor management through a series of prescriptive tables keyed to climate zones. These tables consider general categories of exterior cladding including vented (vinyl and polypropylene) and reservoir (absorptive) claddings.

VENTED AND RESERVOIR (ABSORPTIVE) CLADDINGS

Vented claddings – like vinyl siding and polypropylene siding – allow air circulation between the water-resistive barrier/structural sheathing and the exterior shell. Vinyl siding and polypropylene siding act as vented cladding because they do not hold water against the building. The naturally occurring air gap under the material allows venting to dry the wall to the exterior. Reservoir (absorptive) claddings like fiber cement do not breathe (see absorptive claddings) and hold moisture against the building.

TABLE 1.

Fiber cement lap siding (primed all surfaces)	1.5 perms
Vinyl siding	70 perms

Table 1 shows typical perm ratings for fiber cement and vinyl sidings (BSC, 2015). Any material that absorbs moisture and presses against the exterior sheathing/WRB acts as a reservoir (absorptive) cladding. For example, fiber cement, stucco and adhered masonry applied directly to the outer wall without a rain screen act as reservoir (absorptive) cladding.

A higher perm rating indicates the ability of a product or assembly to allow water vapor to escape which helps to keep exterior walls dry.

The 2021 IRC identifies the siding types that provide sufficient venting to prevent water vapor from remaining trapped against the structure.

A. Vented cladding shall include vinyl, polypropylene or horizontal aluminum siding, or brick veneer with a clear air space as specified in Table R702.7(3). (IRC, 2021)

* EPA (2013) *Moisture Control Guidance for Building Design, Construction and Maintenance,* EPA 402-F-13053, Washington

VAPOR MANAGEMENT METHODS

The movement of water vapor through an exterior wall depends on multiple factors. The first comes with the vapor permeance of the interior and exterior wall assemblies. The second comes with balancing air temperatures and humidity between the wall's interior and exterior surfaces. The prescriptive building codes simplify the balance between surface permanence and insulation by reducing wall assemblies into three layers:

1) The interior (paint, drywall and vapor retarder)

2) The cavity insulation R-value and vapor permeability (porous, kraft paper-backed or non-permeable, such as closed-cell spray foam insulation)

3) The water vapor permeance of exterior layers (sheathing, water-resistive barrier and cladding)

A fourth layer sometimes applied to a wall that further assist in water vapor management is continuous exterior insulation. Here, insulated vinyl siding acts as continuous exterior insulation which adds to vapor management by moving the dew point of the wall further outward and providing a water vapor management solution and additional insulation.

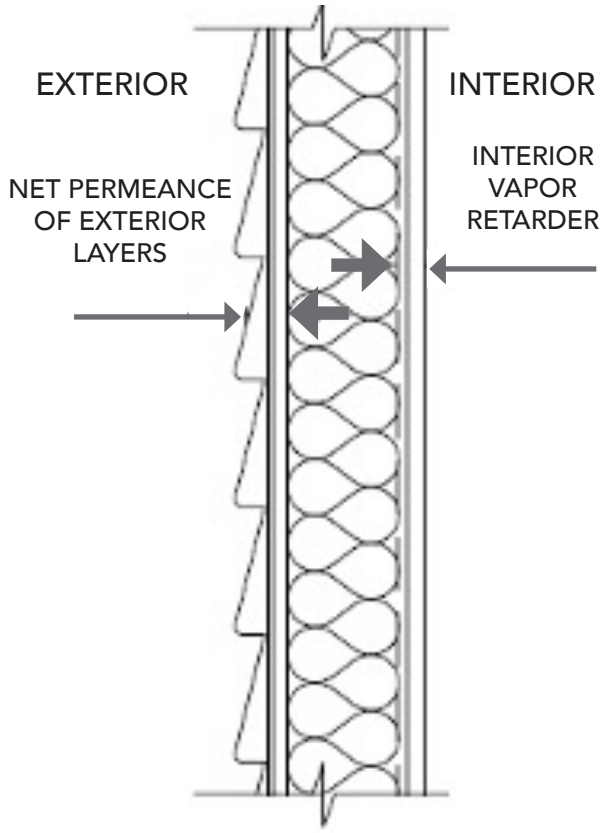

Figure 1 The three layers of the wall assembly and their roll in vapor transmission

Permeance Control and Temperature Balance

Two methods exist to prevent air-born water vapor from getting into the wall cavity; the first method entails blocking moisture with a vapor barrier. The second method involves isolating the temperature difference between the wall's interior and exterior to mitigating the thermodynamic effects that drive water vapor into a wall. Generally, the best approach combines appropriately specified vapor barriers in the correct locations for the climate and either vented cladding, exterior insulation or a combination of the two.

Permeance control is the traditional method of reducing moisture accumulation inside a wall by installing a suitable interior vapor retarder—in most climates. The building code follows this conventional approach for wall assemblies that do not use continuous outside insulation. This method remains a common practice in the building trades. Here a vented cladding, such as vinyl and polypropylene sidings, allows a wall to dry to the exterior while reservoir (absorptive) claddings, such as conventionally applied fiber cement, stucco, brick (built without an air space) and adhered masonry, do not.

The temperature-controlled design approach focuses on continuous exterior insulation to control the wall assembly's internal temperatures. Even if the outer layers are low perm, the exterior insulation will protect the wall against diffusion-based moisture accumulation. The key factor for success is having an adequate ratio of continuous exterior insulation to interior cavity insulation for a given climate zone.

VAPOR MANAGEMENT IN THE 2021 IRC

The 2021 IRC addresses the four layers of typical wall assemblies for each climate zone. Table 2, R702.7(3), provides several options combining different interior vapor barriers with vented cladding and exterior insulation options. See Table 2

TABLE 2.

TABLE R702.7(3) CLASS III VAPOR RETARDER

CLIMATE ZONE	CLASS III VAPOR RETARDER PERMITTED FOR:[a,b]
Marine 4	Vented cladding over wood structural panels.
	Vented cladding over fiberboard.
	Vented cladding over gypsum.
	Continuous insulation with *R*-value ≥ 2.5 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 3.75 over 2 x 6 wall.
5	Vented cladding over wood structural panels.
	Vented cladding over fiberboard.
	Vented cladding over gypsum.
	Continuous insulation with *R*-value ≥ 5 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 7.5 over 2 x 6 wall.
6	Vented cladding over fiberboard.
	Vented cladding over gypsum.
	Continuous insulation with *R*-value ≥ 7.5 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 11.25 over 2 x 6 wall.
7	Continuous insulation with *R*-value ≥ 10 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 15 over 2 x 6 wall.
8	Continuous insulation with *R*-value ≥ 12.5 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 20 over 2 x 6 wall.

a. Vented cladding shall include vinyl, polypropylene, or horizontal aluminum siding, brick veneer with a clear airspace as specified in Table R703.8.4(1), and other approved vented claddings.

b. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

Table 2. R702.7(3) presents the exterior cladding options for the most common Class III vapor barriers, such as interior latex paints. Table R702.7(3) extends the application of insulated vinyl siding in vapor management from Climate Zone 3 through Climate Zone 7

In addition to plain vented claddings, such as vinyl and polypropylene sidings, Table R702.7(4) also provides options for insulation values available with insulated vinyl siding (R-2 through R-5). This prescription offers a practical application for insulated vinyl siding that addresses water vapor management from permeant (exterior drying potential) and temperature isolation.

Of note, the R-values of exterior insulation required for vapor management do not necessarily coincide with the International Energy Conservation Code (IECC) requirements for thermal insulation in each Climate Zone. However, the IECC provides flexibility in the combination of exterior insulation R-values and cavity insulation. A cost-effective wall design can combine higher cavity insulation with a lower R-value of continuous insulation, such as R-2.5.

TABLE 3.

TABLE R702.7(4) CONTINUOUS INSULATION WITH CLASS II VAPOR RETARDER

CLIMATE ZONE	CLASS II VAPOR RETARDER PERMITTED FOR:[a,]
3	Continuous insulation with *R*-value ≥ 2.
4, 5, and 6	Continuous insulation with *R*-value ≥ 3 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 5 over 2 x 6 wall
7	Continuous insulation with *R*-value ≥ 5 over 2 x 4 wall
	Continuous insulation with *R*-value ≥ 7.5 over 2 x 6 wall
8	Continuous insulation with *R*-value ≥ 7.5 over 2 x 4 wall.
	Continuous insulation with *R*-value ≥ 10 over 2 x 6 wall.

a. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

Table 3 R702.7(3) presents the exterior cladding options for Classie II vapor barriers, such as kraft-faced fiberglass batts. Note that climate zone 3 allows external insulation values of R ≥ 2, while zones 4, 5, and permit values of R ≥ 3, for interior vapor retarder options.

OPPORTUNITIES

The 2021 IRC addresses water vapor management in exterior walls by prescribing specific interior vapor barriers and exterior cladding or continuous insulation assemblies. Many of those assemblies include a Class III interior vapor barrier (the most common type) with vented cladding, specifically identifying vinyl and polypropylene sidings.

While plain vented cladding is not an option with a Class II interior vapor barrier (the second most common type), the R-values prescribed for continuous exterior insulation fall into the range achievable by insulated vinyl siding (R-2 through R-5).

Awareness of water vapor management's importance and the cost-effective solutions for exterior cladding provided by vinyl siding, polypropylene siding and insulated vinyl siding offers manufacturers the opportunity to contribute to the built environment resilience and durability.

REFERENCES

TABLE 4.

CLASS	ACCEPTABLE MATERIALS
I	Sheet polyethylene, non perforated aluminum foil, or other approved materials with a perm rating of less than or equal to 0.1.
II	Kraft-faced fiberglass batts, vapor retarder paint, or other approved materials are applied following the manufacturer's installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0.
III	Latex paint, enamel paint, or other approved materials are applied following the manufacturer's installation instructions for a perm rating of greater than 1.0 and less than or equal to 10.0.

Table 4 R702.7(1) Interior vapor retarder materials and classes.

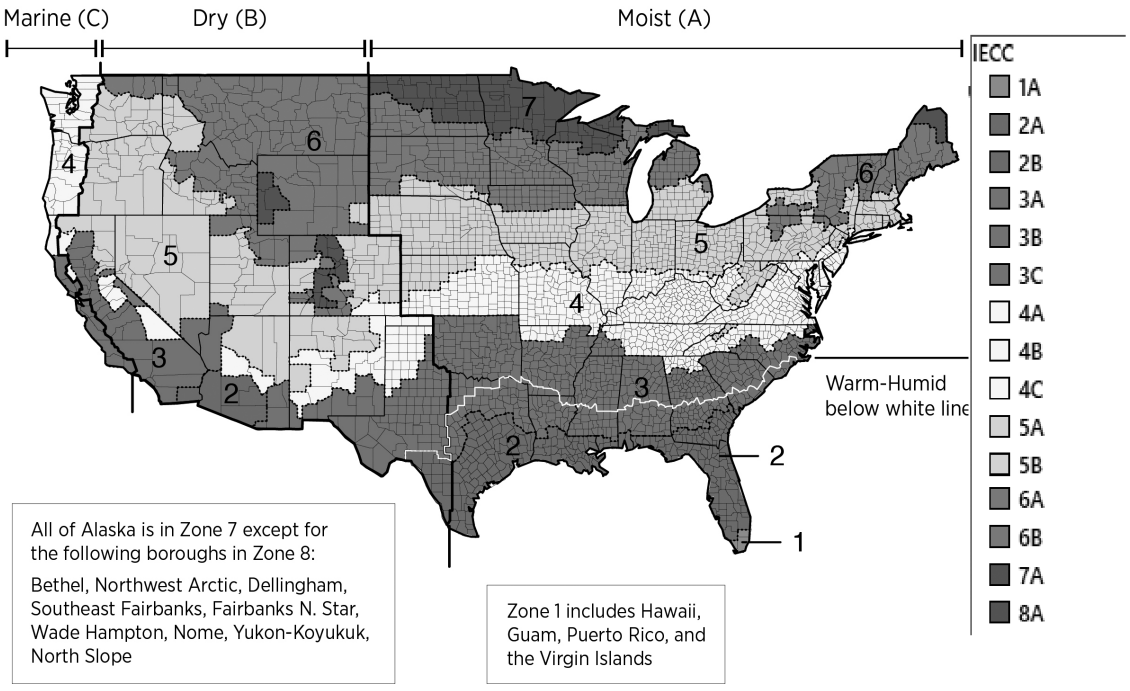

Figure 2. U.S. Climate Zone Map used in the IBC, IRC, and IECC. Note climate zone 4, where a large part of U.S. housing is located.

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