

Avoiding Delegated Disaster

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DELEGATED DESIGN CAN be a valuable project delivery tool, especially in the realm of pre-engineered metal buildings (PEMBs). Chapter 3 of the 2024 *International Energy Conservation Code* (IECC)¹ designates climate zones alphanumerically, where a number from 0 to 8 indicates bands of heating and cooling degree days. Ranging from hotter to colder, Climate Zone 0 is cooling dominant, and Climate Zone 8 is heating dominant. For the letters, “A” denotes humid climates, “B” denotes dry climates, and “C” denotes marine climate. However, in hot and humid climate zones, specifically Climate Zones 1A, 2A, and 3A, the installation of industry-standard vinyl-faced insulation and changing directions of vapor drive often become a silent threat to long-term building performance. The root of the problem lies not in structural failure but in the slow and insidious deterioration caused by improperly specified or misunderstood vapor retarders, most notably the vinyl-faced insulation liner systems often assumed to “check the box” for thermal and vapor performance (**Fig. 1**). This should be a reminder to architects that delegating the design of system components does not mean surrendering oversight of the holistic design.

THE LINER SYSTEM PROBLEM

In many PEMB systems, the insulation is a component of the PEMB manufacturer’s “package” and is within the boundary of the deliverables. However, the insulation is not necessarily “designed” by the PEMB manufacturer but rather “included” in the system. Most architects assume that, because the insulation is included as a component in the package, it will be designed by a professional. But this is not necessarily the case. The insulation delivered is typically installed as a continuous layer draped over the top of primary framing members, with the vinyl facer acting as both vapor retarder and interior finish. This system is widely used for its speed and affordability. But the vinyl facer’s vapor permeability characteristics (often approaching those of a Class I vapor retarder) are neither appropriate nor generally code compliant in hot-humid regions.

The sheet metal used for exterior siding is effectively vapor impermeable at the material

level and may behave as a Class I vapor retarder by diffusion, though real-world performance is governed by joints, penetrations, and air leakage. In such cases, both sides of the wall assembly, the field of the interior vinyl facer and the exterior cladding, are essentially impermeable to moisture vapor. This configuration may trap any moisture that infiltrates within the wall cavity, with nowhere for it to escape or dry out. Over time, this can lead to a buildup of trapped humidity with a likelihood of reaching a condensing surface, resulting in corrosion of metal components, deterioration of insulation performance, and the growth of mold.

Often these systems do not include the critical and separate role of the air barrier. A properly installed air barrier limits bulk air movement through the enclosure. Because moving air transports water vapor, uncontrolled air leakage is the primary mechanism by which moisture is delivered to cooler surfaces where condensation can occur. An air barrier reduces this risk by stopping airflow driven by pressure differentials. Depending on the selected material, an air barrier may remain vapor permeable, allowing drying by diffusion while still preventing bulk air movement. Air barriers can be anywhere in the assembly, but common commercial practice is to place them on the sheathing (which these systems may not and often do not include). Air barriers are required by Section C402.6 of the 2024 IECC, with a limited exception for Climate Zone 2B, based on energy-modeling assumptions rather than enclosure durability considerations.¹

We also have the “pinch point” (**Fig. 2**). Often, the insulation is draped over the purlins and girts, essentially pinching and reducing the insulation value. The pinched insulation elevates the likelihood of thermal bridging (metal is

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Figure 1. Typical vinyl-faced insulation at the exterior enclosure.

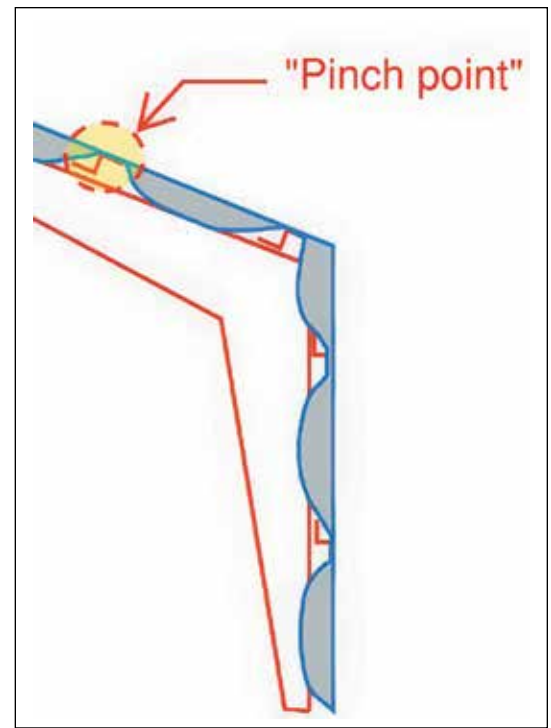


Figure 2. Insulation pinch point.

an excellent conductor) and warm, moist air reaching a condensing surface faster at these pinch points.

Let us break this down for a building enclosure in Climate Zone 3A. This is a region where some jurisdictions have amended the 2009 energy codes, and, specifically in Oklahoma, demand for cost-effective buildings for religious, retail, and industrial companies favors the PEMB designs as part of their development strategy. Often, the delegated nature of the PEMB components gives the architect the false sense of security that the design of the building enclosure will be handled by the PEMB manufacturer, including ensuring nuanced sections of the building code (like Chapter 14) will be compliant. However, the PEMB manufacturers often focus on structure and compliance with wind and lateral resistance. The result could be considered a "scope gap" between the architect and the PEMB manufacturer.

Summer

In summer, warm, moist air on the outside of the enclosure drives toward the interior cooler, drier air. This is based on simple thermodynamic systems, namely that both heat and moisture move from high concentrations to lower concentrations. Simply put, hot moves to cold and wet moves to dry (**Fig. 3**).

The warm, moist air first meets the metal panel system and "heats" it (the heat is often increased by solar radiation). The warm, moist air moves through all penetrations under pressure

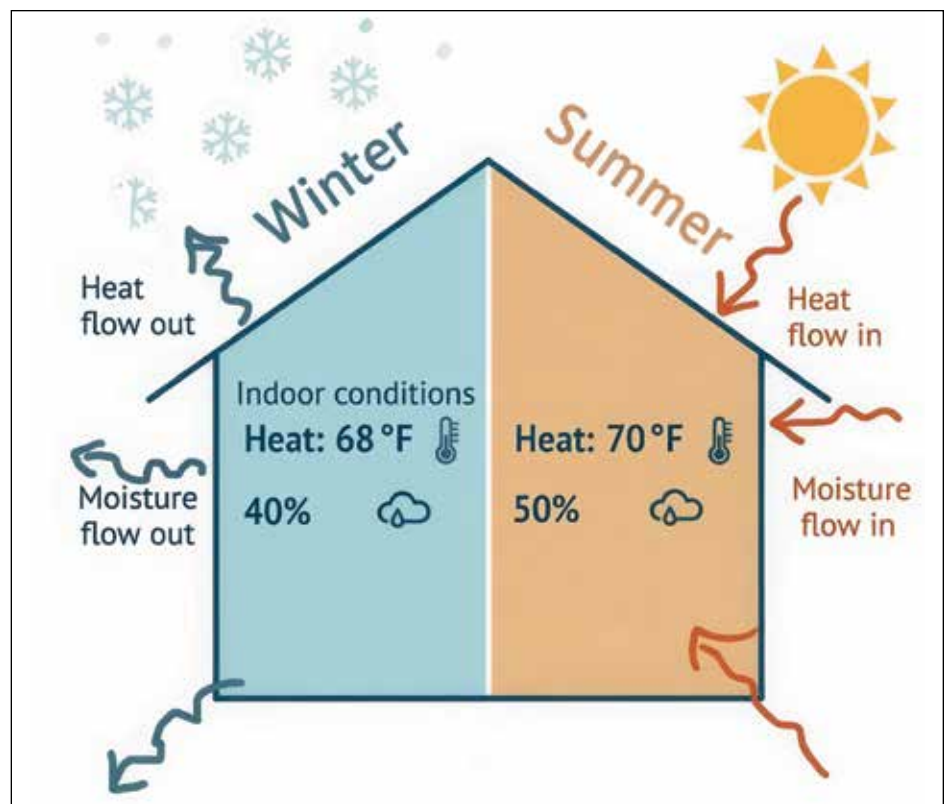


Figure 3. Seasonal heat and moisture transfer.

differentials driven by wind, stack effect, and mechanical systems and finds a cool condensing surface.

Meanwhile, from the interior, we will assume the air is cooler (say, 70°F [21°C]). This causes the steel, which is an excellent conductor, to

become much cooler as the air-conditioning systems remove the heat. When the warm, moist outdoor air meets the cool, dry surface, we get condensation at the "dew point temperature." This is typically resolved by moving the condensing potential away from

a condensing surface with a continuous thermal-resistant layer. However, where the insulation may be pinched, the reduced insulation value increases the potential for condensation at the steel. The other issue is that the vinyl facer often provided, but not necessarily designed, is a vapor retarder, meaning the condensation may occur on the insulation side of the vinyl facer when moisture-laden air is cooled below its dew point, effectively wetting the batt insulation.

Winter

The opposite effect happens in winter. Warm air from the interior (the humidity level on the interior is especially important to understand in this scenario) drives to the exterior colder, drier air. In this scenario, the vinyl-faced vapor retarder helps reduce the warm, moist air moving through the wall, but only if it is sealed and acts as a continuous air barrier. At the pinch points, you may still have a thermal bridge that causes the vapor to condense on the interior side of the wall assembly. The winter conditions are limited to a few short months. The risk is greater during summer.

CLIMATE ZONES 1-3: WHAT DOES THE CODE SAY?

When vapor retarder misapplication leads to mold, corrosion, or insulation collapse, the root cause often traces back to a gap in design responsibility or installation issues. Delegated design does not absolve the architect of record from informing the criteria for the enclosure on the construction documents.

Chapter 14 of the *International Building Code* (IBC) is one of the more referenced sections of the code when it comes to building enclosure claims. Now that it is very prescriptive about these systems, it often sets the “minimum standard” for designers. Chapter 14 of the IBC has specific requirements for vapor retarder applications. This prescriptive application of the vapor retarders started showing up in the IBC beginning in 2009. Since then, it has been refined, and the 2024 edition of the IBC has further developed the application.²

In accordance with the 2024 IBC, a Class I vapor retarder is not permitted on the interior side of frame walls in Climate Zones 1, 2, and 3. However, the scenario that most of these types of buildings experience is exactly that: a Class I vapor retarder on the interior face of the frame. Note that this prohibition applies to prescriptive interior vapor retarder placement in framed

wall assemblies and does not prohibit alternative enclosure designs justified by analysis or compliant assemblies utilizing responsive vapor retarders.

In the 2024 IBC, Table 1404.3(1) (Table 1 in this article) provides some defining criteria for classes of vapor retarders, while Table 1404.3(2) (Table 2 in this article) indicates the permitted areas of use.

As you can see from Table 1404.3(2), Climate Zones 1 and 2 are not permitted to have a Class I or II vapor retarder. They are permitted to have a Class III vapor retarder. For Climate Zones 3 and 4, a Class I vapor retarder is not permitted, but a Class II vapor retarder is permitted under certain conditions that the designer should note. The new development of responsive vapor retarders in the industry is noted by the 2024 IBC for the first time, and designers should use caution when using these products to ensure code compliance.

PRACTICAL RECOMMENDATIONS

To avoid vapor-related PEMB failures in warm climates, consider the following recommendations:

- Avoid blindly delegating the building enclosure.
- Put the bulk of R-value and vapor control outboard of the framing/metal skin.
- Use an interior framed wall with its own air/vapor control layer inside the PEMB shell, treating the PEMB as a rainscreen cladding.
- Use continuous insulation on the exterior side of the structure. Note that the 2024 IECC requires continuous insulation with an R-value of 6.5 for metal buildings in Climate Zone 3A (see Table C402.1.3).¹
- Do not place a vapor retarder where it is discouraged or not required. Use alternate facings that are vapor permeable.
- Provide assemblies with a defined drying pathway appropriate to the climate and enclosure strategy.
- Apply the critical air barrier. In this case, the exterior makes the most sense to prevent air from entering the insulation from the exterior.
- Coordinate all penetrations in the wall assembly.
- Control interior relative humidity aggressively.
- Be explicit in specifications and shop drawing review of the final wall assembly.

TABLE 1. 2024 *International Building Code* Table 1404.3(1), Vapor Retarder Materials and Classes²

Vapor retarder class	Permeability (perms)	Acceptable materials
I	≤ 0.1 perm	Sheet polyethylene, nonperforated aluminum foil, or other approved materials
II	> 0.1 and ≤ 1.0 perms	Kraft-faced fiberglass batts, vapor retarder paint, or other approved materials
III	>1.0 and ≤ 10 perms	Latex paint, enamel paint, or other approved materials

TABLE 2. 2024 *International Building Code* Table 1404.3(2), Vapor Retarder Options²

Climate zone	Vapor retarder class Ia	Vapor retarder class IIa	Vapor retarder class III
1, 2	Not permitted	Not permitted	Permitted
3	Not permitted	Permitted ^c	Permitted
4 (except Marine)	Not permitted	Permitted ^c	See Table 1404.3(3)
Marine 4, 5, 6, 7, 8	Permitted ^{b,c}	Permitted ^c	See Table 1404.3(3)

- a. A responsive vapor retarder shall be allowed on the interior side of any frame wall in all climate zones.
- b. In frame walls with a Class I vapor retarder on the exterior side, use of a Class I interior vapor retarder that is not a responsive vapor retarder shall require an approved design.
- c. Where a Class I or II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table 1404.3(4) and the Class I or II vapor retarder shall be a responsive vapor retarder.

- Require hygrothermal analysis in accordance with accepted building science methodologies (for example, ASHRAE 160, *Criteria for Moisture-Control Design Analysis in Buildings*) during schematic design and PEMB submittals.

CONCLUSION

Avoiding delegated disaster requires proactive coordination and a clear understanding of building science principles, not just structural calculations. Architects, engineers, and specifiers must reclaim the responsibility of vapor control from the murky world of delegated design and bring building enclosures back into the light of accountable, coordinated performance. 

REFERENCES

1. International Code Council, *International Energy Conservation Code*. Country Club Hills, IL: International Code Council, 2024.
2. International Code Council, *International Building Code*. Country Club Hills, IL: International Code Council, 2024.

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