

How to specify roofs for cold storage and freezer buildings

By GAF and James R. Kirby, AIA

PUBLISHED: NOVEMBER 11, 2019 | UPDATED: NOVEMBER 11, 2019



We use cookies and other tracking technologies for performance, analytics, marketing, and more customized site experiences. By continuing to browse this site you are agreeing to our terms. Learn more about these in our [Privacy Policy](#). AIA reserves the right to delete content and suspend user accounts that it determines to be inappropriate.

[I consent to cookies](#)

[Want to know more?](#)

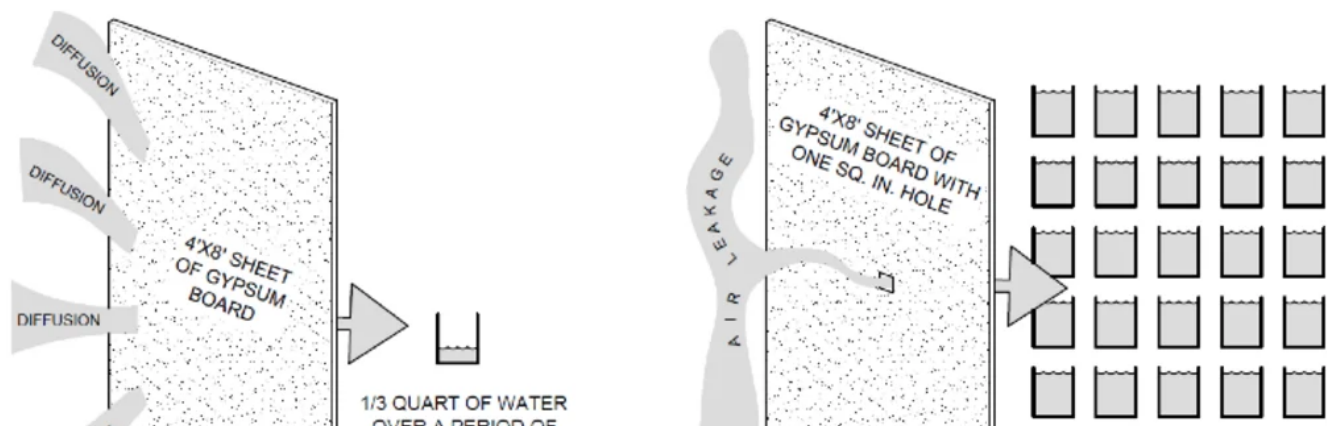
AIA partner GAF explains what architects need to know about vapor drive and thermal bridging for cold storage applications.

A “cold storage building” is a building or a portion of a building or structure designed to promote the extended shelf life of perishable products.

When designing the roof of a cold storage building, a major concern is the significant vapor drive that occurs predominantly from the warmer exterior toward the colder interior. This requires two critical measures for roof design: proper placement of a vapor retarder to manage the vapor drive and proper detailing to prevent air infiltration or exfiltration at enclosure transitions and penetrations. The reduction or elimination of thermal bridges is also important; a highly effective thermal boundary keeps the items within the cold storage building at the proper temperature all while using the least amount of energy.

Cold storage buildings are maintained at temperatures that are most often much lower than the exterior temperature. For these cases, the warm, moist outside air wants to move to the interior of the building. The direction of the vapor drive is predominantly from the exterior to the interior. This is especially the case in Southern climates and is generally true for most geographic locations in the U.S. for most months of the year. This means the roofing membrane will act as the vapor retarder and air barrier, keeping vapor and air from getting into the roof system and creating condensation problems. (This blog about [condensation, dew point, and roofing](#) provides a more thorough discussion.)

Air-transported moisture is a bigger issue than vapor drive because of the comparative amount of actual moisture transported by each process. As shown in Figure 1, air leakage brings in more moisture than vapor diffusion.



We use cookies and other tracking technologies for performance, analytics, marketing, and more customized site experiences. By continuing to browse this site you are agreeing to our terms. Learn more about these in our [Privacy Policy](#). AIA reserves the right to delete content and suspend user accounts that it determines to be inappropriate.

FIGURE 1: VAPOR DIFFUSION VS. AIR LEAKAGE, WHERE INTERIOR TEMPERATURE IS 70 DEGREES F AND RELATIVE HUMIDITY IS 40%. (SOURCE: BUILDING SCIENCE CORPORATION)

Accordingly, it is critical that a vapor retarder system be continuous when used in cold storage buildings so they also serve as an air barrier. (For more detail, [see this blog post about air barriers and vapor retarders](#)).

Basic concepts of cold storage design

A cold storage building should have an uninterrupted, continuous building enclosure with these attributes:

- Adequate amounts of insulation and an appropriate attachment method to maintain interior temperature and minimize thermal loss
- Compensation for thermal expansion and contraction
- Control of air and water vapor movement

The most common way to achieve these objectives is to use an Exterior Envelope System (EES). The EES method uses a vapor retarder that is located on the exterior side of the building's structural system.

Roof insulation

In order to minimize the potential for interior condensation, use appropriate amounts of insulation so the interior surfaces of the building enclosure are kept above the dew point. Pay close attention to the type of cold storage and the typical temperatures. For example, if it's a typical cooler with an interior temperature range of 32 to 55 degrees F, your minimum R-value for the roof insulation is 30; holding freezers with an interior temperature range of -20 to 25 degrees F would need a minimum R-value of 45.

Roof penetrations, such as mechanical curbs or roof hatches, and parapets and roof edges should be appropriately insulated and air sealed.

Thermal shorts/thermal bridging

To reduce the effects of thermal shorts, install roof insulation in at least two layers with offset joints—

We use cookies and other tracking technologies for performance, analytics, marketing, and more customized site experiences. By continuing to browse this site you are agreeing to our terms. Learn more about these in our [Privacy Policy](#). AIA reserves the right to delete content and suspend user accounts that it determines to be inappropriate.

Problems occur when there are unwanted paths for air and water vapor movement within the building enclosure. To function properly, the vapor retarder and roof system should be continuous, tied to the wall air barrier, and completely sealed at laps and seams, roof penetrations, and roof-to-wall intersections. Limiting the number of penetrations is prudent.

Vapor retarder perm ratings

Vapor retarders are membranes with relatively low permeance values. There are three classes of vapor retarder materials: Class I, 0.1 perm or less; Class II, greater than 0.1 perm to less than 1.0 perm; and Class III, greater than 1.0 perm to less than 10 perm.

Most roof membranes are Class I vapor retarders. Perm ratings for single-ply membranes range from 0.03 to 0.06 perm. It is important to note that these are *material* ratings; the full vapor retarder/air barrier system needs to be designed and installed correctly for proper functionality.

Cold storage buildings are unique because of their low interior temperatures and the resulting vapor drive and significant potential for air infiltration. Taking into account the science of heat, air, and moisture movement when designing the roof system for a cold storage system is paramount for long-term success.

For additional information, download GAF's new document, "[A Guide to Cold Storage Roof System Design](#)."

AIA does not sponsor or endorse any enterprise, whether public or private, operated for profit. Further, no AIA officer, director, committee member, or employee, or any of its component organizations in his or her official capacity, is permitted to approve, sponsor, endorse, or do anything that may be deemed or construed to be an approval, sponsorship, or endorsement of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.



We use cookies and other tracking technologies for performance, analytics, marketing, and more customized site experiences. By continuing to browse this site you are agreeing to our terms. Learn more about these in our [Privacy Policy](#). AIA reserves the right to delete content and suspend user accounts that it determines to be inappropriate.