WHITE PAPER

DESIGN/BUILD STRATEGIES TO REDUCE THE THREAT OF MOISTURE

Spray foam insulation can play multiple roles in minimizing moisture issues

ICYNENE®

OVERVIEW

In the design process few decisions have as many long-term implications for the performance and durability of a building as the choice of insulation. For the designer, builder and owner, insulation can and should play a multi-faceted role that extends far beyond those noticeable or expected benefits, such as energy savings, comfort and enhanced indoor air quality.

Insulation, in combination with good detailing and quality control, can play a preventive role by minimizing the chances that things could go wrong.

Among the most damaging of potential issues are those related to moisture (i.e. mold, wood rot and corrosion), which can pose a serious threat to building performance, health, safety and durability.

Most moisture-related problems in homes and buildings are caused by four key mechanisms of water movement:
(in order of importance)

1. **Bulk Moisture Transfer** (i.e. leakage of snow, rain, groundwater leaks, floods) will usually saturate building assemblies and provide the potential for large amounts of moisture accumulation that can overwhelm their ability to dry out.
2. **Wicking/Capillary Action** involves porous materials absorbing moisture and transferring it to other construction materials (e.g. to wood, concrete, gypsum board). This mechanism can move moisture around once things get wet.
3. **Air Leakage** is a prime factor behind condensation, which occurs on cold surfaces when warm moist air leaks from the hotter side to the cooler side of a wall or attic assembly. In air-conditioned buildings condensation can form on the interior side of the assembly; in heated buildings it can form on the exterior side of the building assembly (i.e. on the sheathing.)
4. **Diffusion** occurs in areas where moisture moves from higher absolute humidity to lower absolute humidity, which can also lead to condensation. This tends to be a much slower process than air leakage driven moisture. But it is the reason, for example, why a vapor retarder/barrier is required in some (Northern) Climate Zones.

DESIGNING WITH SPRAY FOAM INSULATION FOR MOISTURE CONTROL

So how does spray foam insulation fit into a design/build strategy for moisture control? It can play multiple roles in addressing the key forms of moisture movement described earlier:

- Its insulating properties can be used to keep surfaces warm and thereby minimize opportunities for condensation to form.
- Its air barrier properties can minimize the movement of moisture-laden air within the building envelope and its associated moisture problems, including condensation.
- Most spray foam products are not a food source for mold should they be exposed to minor wetting.
- Its vapor permeability (open cell products) can enhance its ability to dry out via diffusion should it become wet.
- Some open cell spray foam materials (such as ICYNENE LD-C-50) may get wet if subjected to hydrostatic pressure but they will allow moisture to drain through them.
- Open cell spray foam insulation like ICYNENE will not wick water or contribute to capillary action.
- Closed cell foams can act as a Class 2 vapor retarder (e.g. 1.5" of ICYNENE MD-C-200) where required.
- Closed cell foams don't absorb water (usually less than 4% by volume), even when submerged. (This can be a desirable feature in flood zones for example.)

SPRAY FOAM INSULATION AND MOISTURE CONTROL APPLICATIONS

Here are four applications that demonstrate the role spray foam insulation like ICYNENE can play as part of a moisture control design strategy:

Application 1. Spray Foam as an Air Barrier in Walls[1]

- Both low density (open cell) or medium density (closed cell) spray foam insulation products like ICYNENE LD-C-50 or ICYNENE MD-C-200 can perform as an insulation and air barrier within the wall cavity.
- A key advantage of spray foam insulation over traditional fibrous or rigid board insulation is that it is usually possible to make a continuous air barrier without time-consuming, labor-intensive and costly detailing. Typically, it is only necessary to supplement spray foam by air sealing gaps around windows and doors and in cracks between built-up structural elements.
- Low density spray foam insulation, applied to the interior cavity, can also be supplemented with medium density spray foam like ICYNENE MD-C-200 to create a continuous insulation layer on the exterior. This can help limit moisture ingress from the exterior and help control cavity temperatures to avoid condensation.

A design that incorporates a continuous air barrier around spray foam insulation can:

- Control condensation caused by air leakage by reducing the movement of moisture-laden air near outside walls where the moisture tends to condense
- Help control moisture issues (mold, mildew, rot) related to high interior humidity, especially when used in conjunction with mechanical ventilation
- Minimize the potential for damage caused by wind-driven rain by limiting air leakage that helps drive it
- Improve the ability of drainage planes and cavities on the exterior side of the assembly to prevent water penetration

Creating a continuous layer of medium density spray foam insulation on the exterior offers the additional advantages of:

- Preventing excessive heat loss/gain through framing so there are fewer cold spots to attract condensation on wall surfaces
- Controlling condensation in concealed areas by moderating temperatures and vapor flow in the wall cavity

SPRAY FOAM INSULATION AND MOISTURE CONTROL APPLICATIONS

Application 2. Conventional Vented Attics

When spray applied to the attic floor and connected with the vertical wall insulation, medium or low density spray foam insulation like ICYNENE will provide both an insulation and an air barrier. It is usually easy to envelope structural elements (e.g. ceiling joists, rafters or chords of trusses) to keep them warm and dry.

In colder temperatures, ICYNENE (as an ASTM qualified air barrier) helps address the problem of stack effect by minimizing heat loss through the ceiling. This, in turn, minimizes the potential for warm moist interior air to come into contact with the cold roof surface, thereby, reducing the potential for ice damming in snowfall areas, along with its associated water/moisture damage and health concerns (i.e. mold).

Application 3. Unvented (conditioned) Attics

As an insulation and air barrier, medium or low density spray foam insulation like ICYNENE is approved for direct application to the underside of a roof deck to convert an attic into an indirectly conditioned space.[2]

In an unvented or conditioned attic design, spray foam insulation has multiple moisture control benefits:

- Light density spray foam insulation (e.g. ICYNENE LD-C-50) will allow drainage to quickly pinpoint where leaks are occurring for easier repair prior to any long term damage of the roof sheathing. As the insulation material is unaffected by the wetting/drying process, it can maintain its original performance.
- Medium density spray foam insulation (e.g. ICYNENE MD-C-200) can help deflect water away from the interior in periods of extreme weather, such as hurricanes.[3]
- Sealing soffit vents in an unvented attic assembly also helps control the penetration of rainwater or wind-driven moisture for added durability.
- In conditioned attic assemblies, the attic space typically remains within about 5°F of the directly conditioned living space below, with a relative humidity much lower than ambient. The potential for condensation is significantly reduced, along with the potential for structural rot.

SPRAY FOAM INSULATION AND MOISTURE CONTROL APPLICATIONS

Application 4. Basements and Below Grade Walls

Either medium or low density spray foam insulation like ICYNENE can be applied to basement walls to provide insulation and an air barrier.[4] In below grade applications framing should be inset from concrete and block walls to allow insulation to be sprayed as a separator between framing and concrete.

Medium density spray foam insulation like ICYNENE MD-C-200 is ideal for below grade applications because it will not absorb moisture and may be specified by some authorities (e.g. FEMA) to provide extra protection in areas where there is a higher risk of flooding.[5] It can also be used as a Class 2 vapor retarder where required by the applicable code.[6]

As an insulation and air barrier, ICYNENE also minimizes the potential for warm, moist air to move through the building envelope and to contact cooler surfaces.

In rim joist applications, up to 3 ¼" of spray foam can be left exposed without invoking the Code requirement for a thermal barrier. This can provide a significant energy performance improvement at minimal cost.

There is a tremendous opportunity to enhance your moisture control strategy by specifying spray foam insulation. It is a decision that will let you push the envelope of design to deliver significant ongoing energy savings, comfort, building health and far greater peace of mind.

End notes

1. *Light Density foam will typically have a modest vapor permeance (that allows bi-directional drying). A vapor barrier paint/primer on the interior of the drywall can provide the needed vapor protection required by Code (in northern Climate Zones).*
2. *In cold climates, if required, a vapor barrier paint/primer on the interior of the foam can provide all the needed vapor protection required by Code.*
3. *A study conducted by The Alan G. Davenport Wind Engineering Group at the University of Western Ontario showed that a home employing spray foam and the unvented attic assembly performed far better than a traditionally vented home under hurricane conditions. The traditionally vented house allowed wind-driven rain in through the soffit vents, gable vents and ridge vents.*
4. *In cold climates, if required, drying will occur to the interior. Avoid using a vapor retarder on the interior.*
5. *ICYNENE MD-C-200 meets Federal Emergency Management Agency's (FEMA) criteria for resisting water absorption.*
6. *ICYNENE MD-C-200 has a vapor permeance of less than 1 perm at a minimum thickness of 1.5 inches (38.1 mm).*

ICYNENE is a registered continuing education provider. For more information visit *www.Icynene.com/continuing-education*.

Learn more about the application of ICYNENE and spray foam insulation for moisture control in building design and construction. Call 1.800.758.7325 or email residentialapplications@icynene.com.

Explore the gallery of residential building projects at www.icynene.com/icynene-residential-project-gallery.