

Understanding Moisture Flow

The First Step In Preventing Moisture-Related Damage

The flow of moisture through the building envelope is a force of nature, but its side effects can cause significant damage to a building and the health of those who occupy it. The most common moisture-related problems begin when moisture infiltrates a wall cavity, becomes trapped and saturates the building components inside.

The most serious moisture damage threat to building owners and design professionals is mold growth.

Extended exposure to moisture can decrease the thermal resistance of insulation, thereby making the building less energy efficient. In addition, continuous saturation can cause wood studs to rot, metal studs to corrode and standard gypsum board to break down. The most serious moisture damage threat to building owners and building and design professionals, however, is mold growth.

Mold can form on any surface, as long as it has a food source, moderate temperatures,

oxygen and sufficient moisture available. The best example of a food source in a wall assembly is any material that is cellulose-based, such as wood or paper. In the buildings of today, mold food sources abound in the form of standard, paper-faced drywall, wood studs and wood-based sheathings. Once moisture comes in contact with a food source, long-dormant mold spores are revived and quickly propagate into mold colonies, which deteriorate building materials, degrade indoor air quality and can cause severe headaches and respiratory ailments among building occupants.

Fortunately, building and design professionals can prevent such problems by implementing the proper moisture management strategies into the building envelope. A good first step is learning about moisture flow mechanisms—the forces that drive moisture through the building envelope.

MOISTURE FLOW MECHANISMS

There are four moisture flow mechanisms: gravity, capillary suction of water, airborne movement of water vapor and water vapor diffusion. An important component of moisture management is learning how they operate and the best way to impede them.

Gravity

Gravity moves rainwater down the building's exterior surfaces. If there are openings in the exterior wall assemblies—particularly downward-sloped openings—water will pass through them. Builders can counter this mechanism by using shingles and flashings to divert rainwater from the exterior. Wherever joints are located in the building envelope, it's best for builders to overlap the components in shingle fashion so rain can't enter and to ensure that there are no reversed laps. Drainage holes are helpful along horizontal and sloped surfaces because if water does get behind those surfaces, it can escape through these holes. All vertical joints should be protected with sealants, gaskets or covers, depending on what works best for each location.

FEATURED PRODUCTS

MemBrain™ Smart Vapor Retarder & Air Barrier Film

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MemBrain™ is a smart vapor retarder that changes its permeability to water vapor as ambient humidity changes.

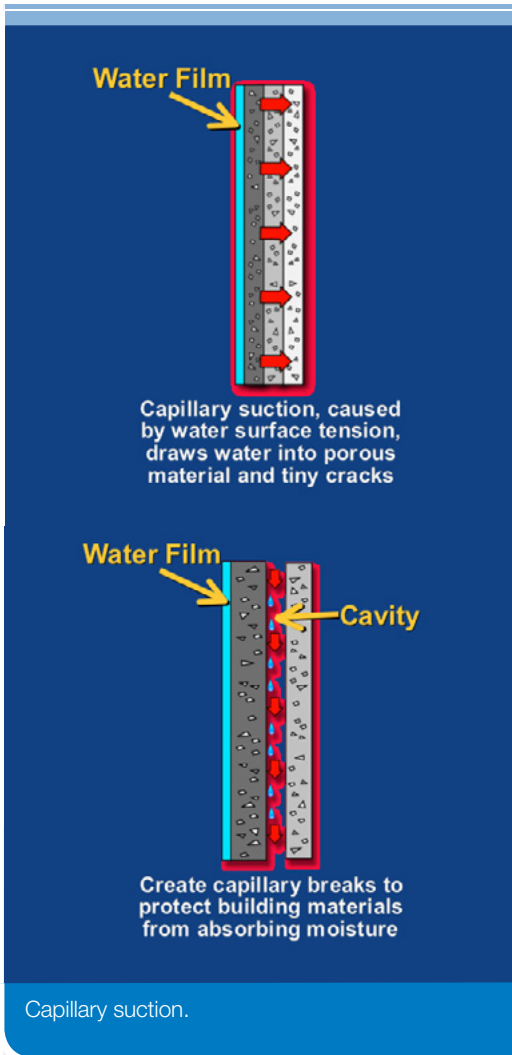
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Capillary Suction

Capillary suction is a result of the surface tension of water. Water is drawn in through tiny pores in building materials, often so small they are invisible to the eye. To hinder this moisture flow mechanism, it is best to “break” the continuity of materials from the exterior through to the interior to obstruct the path of moisture. Builders can create breaks in the components with small cavities that prevent moisture from migrating through all of the layers of materials. Even very narrow breaks work to prevent capillary flow into the building. These spaces should drain and vent to the exterior so drying can occur. It is also wise to select moisture-tolerant exterior wall materials, such as concrete and masonry.

Airborne Movement of Water Vapor

Air movement can bring a large amount of moisture into a building if it is not impeded by good construction practices. Compared to moisture entering a building by water vapor diffusion, moisture carried into a building by air can be up to 100 times greater. For example, a 4 x 8-foot sheet of gypsum board will permit up to 1/3 of a quart of water to pass through it over a heating season in a cold climate. However, if you were to open a 1-inch hole in that board to permit airflow, airborne moisture flow could add up to 30 more quarts of water over the same time period. This phenomenon creates an excellent case for making wall assemblies airtight and preventing moisture from condensing on cold surfaces.

Water Vapor Diffusion

Water vapor will pass, or diffuse, through building materials whenever areas of high vapor pressure and low vapor pressure exist on opposite sides of that material. This movement is from the high vapor pressure side of the material to the low pressure side. The test method for determining the water vapor permeance of any building material is ASTM E96. This test measures diffusion using two possible means — the dry cup method, also known as Method A or the desiccant method, and the wet cup method, also referred to as Method B or the water method.

Smart vapor retarders provide the best moisture management, as their permeance changes with the seasons.

The best way to prevent water vapor diffusion with a good vapor retarder. The key characteristic of a vapor retarder is its permeance — the amount of water vapor it allows to pass through, which is measured in a unit called perm. Vapor retarders have a permeance of 1 perm or less. To put things in perspective, 6-mil polyethylene film has a low permeance (0.05-0.06 perm) when compared to common vapor retarder materials and is actually more of a vapor barrier. At the other end of the spectrum are materials, such as unpainted standard gypsum board, that are very permeable and therefore unsuited for vapor retarder use. Smart vapor retarders, however, provide the best moisture management as their permeance changes with the seasons. They serve as a vapor retarder during the winter season when conditions are dry, and become vapor-open during other seasons when conditions are humid, helping to keep the building envelope dry in both seasons.

CHOOSING VAPOR RETARDER MATERIALS

When choosing a vapor retarder material, it is important to look at its moisture resistance rating. As mentioned earlier, 6-mil polyethylene, in humid or dry conditions, is more commonly used as a vapor barrier. Asphalt-coated kraft paper, as found on fiber glass insulation batts, resists moisture until the relative humidity climbs over 80 percent. It then reaches about 3 perm,

so it's generally regarded as a good vapor retarder. Smart vapor retarders, however, impede moisture under dry conditions, with a permeance of about 0.7 or 0.8 perm. But, as relative humidity rises above 60 percent, they dramatically open up to a permeance of up to 36 perm. Gypsum board — with a coat of primer plus two coats of latex paint, all properly applied — is semi-permeable in dry conditions and becomes quite permeable in humid weather. In comparison to the previous materials, standard gypsum board, primed or plain, has little resistance to water vapor.

WALL ASSEMBLIES

The wall assembly is the first place to strengthen a building's moisture resistance, demanding wise exterior cladding choices, adequate insulation, air barriers and vapor retarders. The most common commercial wall assembly is the steel stud cavity, which would typically include a masonry façade and a configuration of high-performance moisture-resistant components. A typical moisture-resistant steel stud cavity design

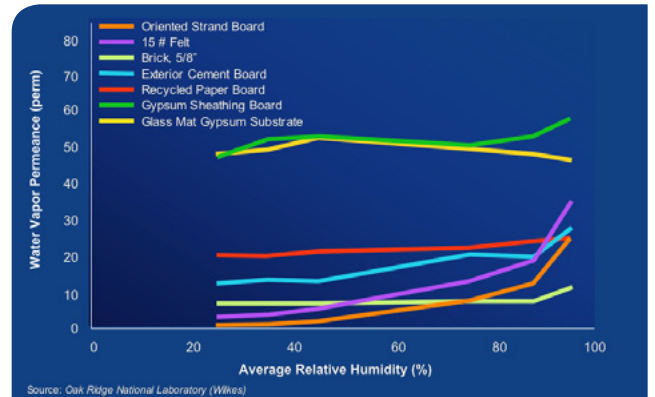
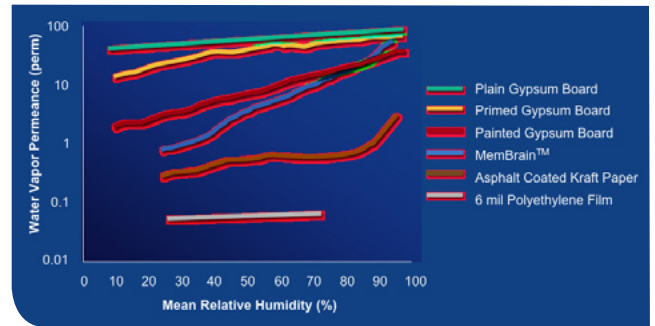
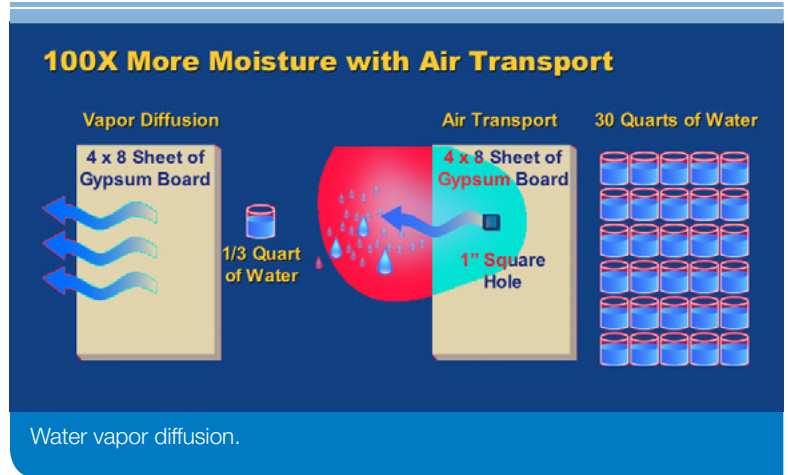
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should begin with a water-resistive barrier (WRB), the first line of defense against rainwater intrusion. Of course, water will enter somewhere, somehow, so it's recommended to use a ventilation and drainage space between the masonry façade and the WRB. It's important to maximize condensation control several ways — first, by using insulating

sheathings. Also, use exterior air/wind barriers, since air can transport considerable moisture into assemblies if unblocked. Installing interior air barriers will help prevent wintertime moisture from migrating and condensing on cold surfaces. In addition, use a smart vapor retarder to both control the wintertime moisture and allow assemblies to breathe during other seasons.

CONCLUSION

The most successful strategists are those who know their enemies well and how they operate in order to be proactive and devise the proper defense. Understanding moisture flow is paramount for building and design professionals who want to design the most moisture-resistant building envelopes, which contribute to more energy-efficient, healthier buildings. The guidelines above should provide a nudge in the right direction.



Permeance of typical vapor retarder materials.

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