

ATMP Handbook

A GUIDE TO ADVANCED THERMAL MOISTURE PROTECTION AS IT APPLIES TO METAL WALL SYSTEMS

CHAPTER 1 | MOISTURE: BUILDING'S PROBLEM CHILD

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WHAT CAUSES MOISTURE PROBLEMS?

There are numerous factors that can lead to moisture intrusion and entrapment.

INTERIOR

Operating conditions inside a building, such as room temperature, humidity, or air movement from pressure differences, can contribute to moisture problems. Incorrect venting of moisture-generating activities and even the blockage of air flow with office furniture or machines can cause moisture build-up.

EXTERIOR

There can be leakage around exterior penetrations and cracks in the wall. Air leakage carrying moisture can seep through improper or failing seals between materials. And there is always the problem of water vapor diffusing through certain porous building materials or wind-driven rain penetrating openings in the building's exterior.



Figure 1.1: Rain and Moisture Control Must Be Addressed in Exterior Wall Construction.

HOW DOES RAIN PENETRATE EXTERNAL WALLS?

Whether planned or accidental, openings exist on the wall surface. These “leakage paths” can be joints between materials and around doors and windows. They can be vents, cracks or simply porous building materials such as brick, block or precast.

The natural forces that drive rain into buildings through these pathways are:

- Kinetic energy
- Surface tension
- Capillary action
- Gravity and
- Air pressure

KINETIC ENERGY is the momentum of wind-driven raindrops that can be downward, horizontal or even upward near the top of the building. Battens, splines and internal baffles can be used to cover drains and vents from such moisture.

SURFACE TENSION AND CAPILLARY ACTION refer to the attraction of water droplets to one another and the force such cohesion can create. This natural phenomenon causes water to cling to and flow along horizontal surfaces such as soffits. It also causes water to move through cracks and pores in the building materials. Drips can alleviate surface tension, and capillary breaks can break down capillary action.



FAST FACT

Capillary action is most active at joints and cracks with both porous and impervious claddings. Sealing the joints is typically unreliable due to continuous weathering of the joint material.

GRAVITY is a particular cause of water penetration with near-horizontal sloped joints between building materials. The most likely problem is an error in design or construction of the flashing, or restriction of the drainage paths. Correcting the drainage path obstructions or installing slope joints can help control this force.



FAST FACT

Smooth exterior wall materials such as glass have a stronger tendency to hold water against gravity.

AIR PRESSURE causes rain penetration because the wind pressure differences across a building create a suction action that draws water through the leakage paths. In other cases, the pressure differences can actually carry the water directly through the openings. Compensating for the differences in air pressure is the primary function of a pressure equalization chamber (P.E. Chamber) on a building's rainscreen.



FAST FACT

Impervious rainscreens are most likely to be breached by air pressure forces, so it is important that they incorporate pressure equalization chambers.

Capillary Action – Open Joint



Surface Tension – Sloped Joint



Gravity – Drip



Kinetic Action – Interior Baffle



Figure 1.2: Proper Joinery Design Can Counteract the Forces That Drive Rainwater Into a Building.

WHAT WALL AREAS ARE MOST VULNERABLE?

Windward facing walls will be subject to more driving rain than leeward walls that are protected. And because wind parts as it flows around a building, the center of the wall will be less vulnerable. Around the sides and top edges of the wall, the wind accelerates, driving more rain into these sections. The taller and narrower the building, the more discrepancy there will be in the wetting intensity.

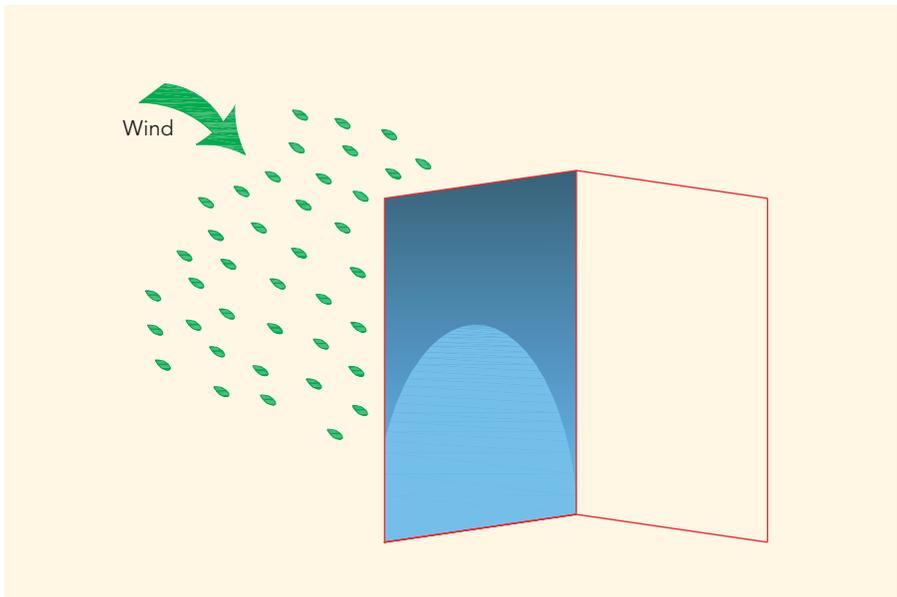


Figure 1.3: Diagram of Rain Moisture Pattern on Exterior Wall. Dark Blue – Very Wet to Light Blue – Wet.

WHAT ARE THE CONSEQUENCES OF ENTRAPPED MOISTURE?

WETNESS

(Decreases the value of your asset)

- Damage to insulation, gypsum, tapes and wraps
- Reduced thermal value from installed insulation
- Corrosion problems on structural metal studs
- Weakened building supports
- Efflorescence in masonry materials
- Fastener corrosion and reduced structural capacity

MOLD AND MILDEW

(Possibly the next asbestos)

- Poor indoor air quality
- Odors
- Deteriorating materials
- Allergies
- Health concerns
- Unsightly stains
- Cleaning expenses
- Lawsuits



FAST FACT

From 2001–2004, over \$10 billion in mold litigation suits were filed.

MOISTURE CONTROL BEGINS WITH WALL MATERIAL SELECTION

*There are two major categories of wall materials:
Porous and Non-Porous or Impervious.*



Figure 1.4: Porous Wall Materials.

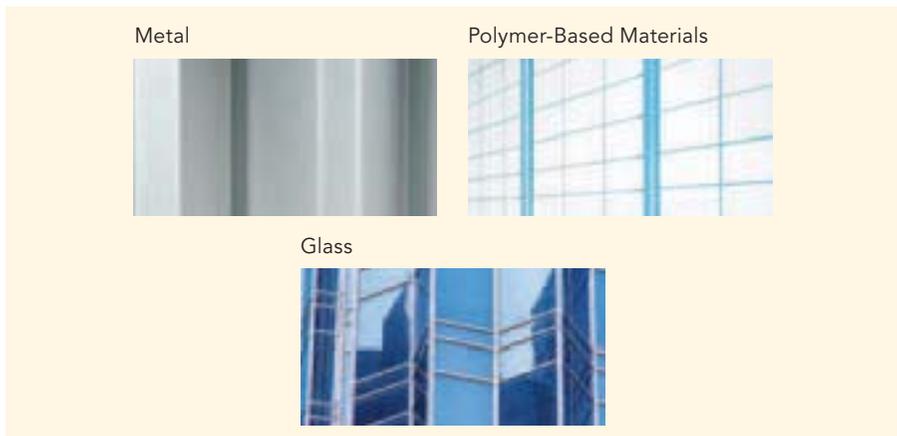


Figure 1.5: Non-Porous Wall Materials.

THE SHORTCOMINGS OF POROUS WALL MATERIALS

Porous building materials can absorb rainwater into the material. The question is where does the moisture go from there?

After a rainstorm, as the sun heats up the surface of porous walls, the moisture turns to vapor. If the vapor pressure difference is greater on the outside of the porous wall material than the inside of the material, it will be driven into the cavity space behind the wall. This is a form of water vapor diffusion. Now the moisture can flow through exterior gypsum and penetrate felt building paper (since both are permeable), flow

through fiberglass insulation and condense as it hits the polyethylene vapor barrier. If the moisture is not controlled by a suitable drainage path, it can run down the wall, attacking the metal sill plate with rust and corrosion. It can also attack interior gypsum at breaks in the vapor barrier, leading to mold and mildew.

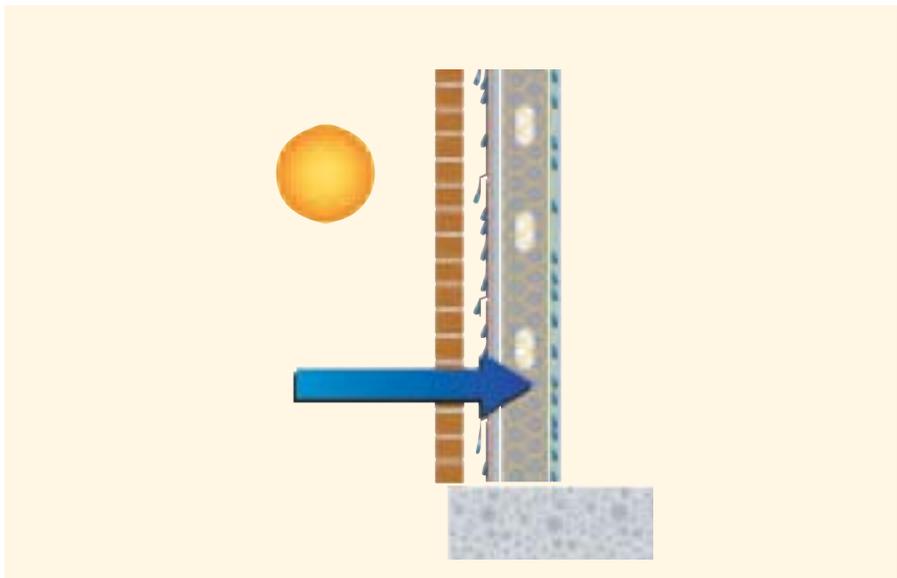


Figure 1.6: Water Vapor Diffuses Into the Porous Wall.

THE ADVANTAGES OF NON-POROUS WALL MATERIALS

Choosing a non-porous material can go a long way toward reducing moisture penetration and the problems it can cause.

Metal cladding systems do not absorb water. Indeed, today's metal wall systems have been so well engineered with advanced joinery

technology that, when properly installed, they dramatically control the entrance and formation of moisture and water vapor.



FAST FACT

Architectural metal cladding types can be single skin panels, plate, thin composite material or insulated composite. None of these absorb water through their surface.

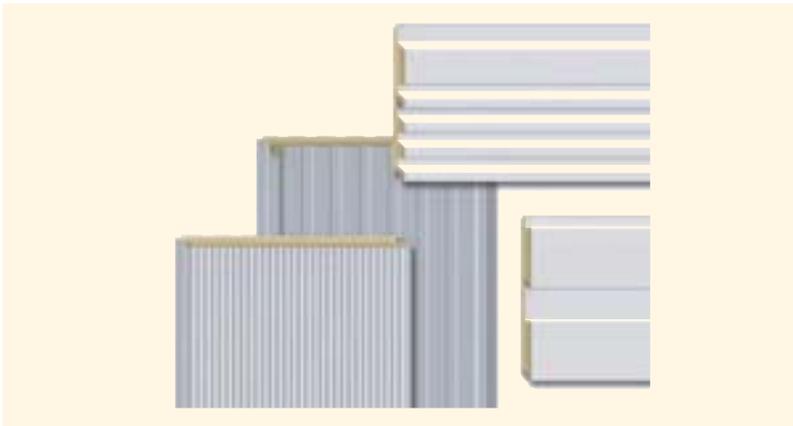


Figure 1.7: Metal Cladding, No Matter the Form, Does Not Absorb Water Through the Surface.

EFFECTIVE MOISTURE CONTROL MANDATES

To achieve a building design envelope that efficiently controls moisture, the following need to be addressed:

- Acknowledge that water will penetrate the exterior skin of most building materials and incorporate durable internal weather barriers, flashing and ventilation to prevent water entry to wall cavities
- Eliminate mold food from surfaces that can get wet
- Use exterior wall materials that remain stable and functional after exposure to transient moisture to avoid wetness as well as mold and mildew problems
- Choose durable moisture control materials that will provide long-term protection, as replacement is costly

– Niklas W. Vigener, P.E. Simpson Gumpertz & Heger



Figure 1.8: Durable Moisture Control Materials Provide Protection and Eliminate Costly Replacement.

FAQs

Q What causes mold to form in walls?

A In order for mold to form, air, moisture and food are required to be present (liquid water isn't necessary; most species propagate with only 40% – 60% relative humidity). Mold is attracted to certain building materials like drywall, wood and carpet; therefore, it is important to maintain drywall cavities and minimize mold food.

Q Is mold toxic?

A Mycotoxins are toxic substances produced by some mold. The health effects of breathing mycotoxins are currently being studied and are not well understood at this time.

Q Why should we be concerned about mold growth?

A One type of mold associated with heavy water damage is *Stachybotrys chartarum*. This greenish-black mold is known to cause severe health effects in some people. Most people have no reaction when exposed to mold. However, the most common reactions are allergic reactions, flu-like symptoms and skin rashes. Mold is also known to aggravate asthmatic conditions. In people with immune deficiency, fungal infections can occur.