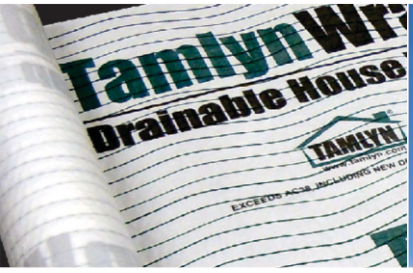
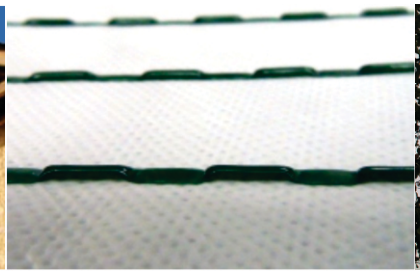
Keys to Moisture Management

Understanding Water Resistant Barriers

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Introduction

Water and moisture related construction defects are one of our nations leading causes of building failures, call-backs and construction litigation. One ASHRAE statistic states that 90% of construction defects ligation is due to water and moisture problems. ASTM estimates that water related defects cost Americans over 9 billion per year. These billions are spent each year repairing finish and structural damage due to water and moisture related issues. Damage from water leaks not only eat into profits but also can diminish professional reputations, and even lead to structural failures and indoor air quality problems. Damage repair from water infiltration typically requires 4 to 5 trade contractors to perform the repairs, which requires significant resources to schedule and correct the damage not to mention inconveniencing the owners.

A common misbelief is that exterior cladding systems do a good job of protecting a home from leaks. All cladding systems can leak its not a matter of if but when. In fact cladding materials like stone, brick and stucco actually store water, and some are designed with weep holes to let water escape because they are not watertight.

Consumers expect their homes to not leak as well as be durable, long lasting, and healthy to live in. Water infiltration can often lead to mold and indoor air quality problems that can require expensive mitigation and cause disruption to the occupants.

Building Standards Require Water Tight Performance:

Codes and building standards have progressively gotten stricter as result of the increase in water related damage in homes.

The 2009 & 2012 International Residential Code (IRC) states…

> *R703.1.1 Water resistance.*
>
> *The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R601.3 (2009), Section R702.7 (2012) of this code.*

The building code is very clear in its requirements to not only to use a weather resistive barrier but also to provide for a drainage path of water to drain from the wall assembly.

The Department of Energy now requires that builders follow the Water Management Check List as part of the qualifications for homes to be certified as Energy Star Homes.

“Energy Star Qualified homes Water Management System Checklist”

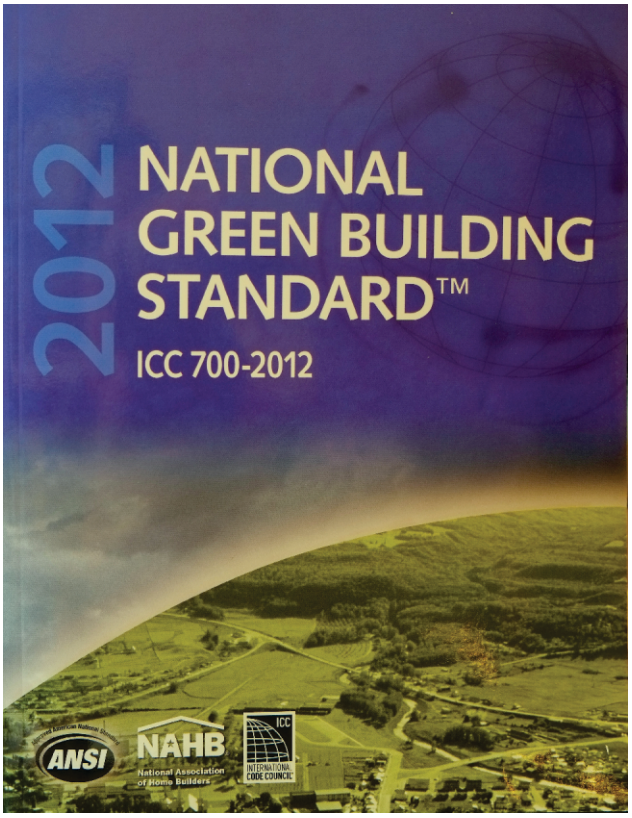
> *"2. Water-Managed Wall Assembly"*
>
> *"2.2 Fully sealed continuous drainage plane behind exterior cladding that laps over flashing in Item 2.1. Additional bond-break drainage plane layer provided behind all stucco and non-structural masonry cladding wall assemblies. 8"*

Water management is also a significant component of green building programs because longer lasting, more durable homes and buildings equates to lower green house gas emissions because less resources and energy are used to repair and replace them. *“The greenest building you can build is one you don't have to rebuild”* says building science consultant Steve Easley.

The 2012 National Green Building Standard recognizes this as well in the Resource Efficiency section of the latest version of the standard and awards bonus points towards a homes green certification for proper water management systems that promote water drainage.

> "*(NGBS) Section 602.8 (5b)"*
>
> *"A cladding material or water resistive barrier with enhanced drainage meeting 75% drainage efficiency determined in accordance with ASTM E2273."*

These important changes in the codes and other building standards will create homes that have fewer leaks, call backs. The result will be less liability for designers and builders as well as create higher quality and longer lasting homes for consumers.



Water Infiltration Damages Homes & Buildings

In order to build homes and buildings that are free from water problems it is important to understand all the mechanisms as to how building components get wet and how building assemblies drain and dry. Wood, in general, is a very green building material that can be very long lasting. There are wood structures in the United States that are over 300 years old and are still in service and performing well.

This home built in 1700's still in use today

Wood has remarkable hygric properties. This means that wood has the ability to absorb small amounts of water and dry out repeatedly and not be damaged. It is however critical to understand that if the wetting rate exceeds a building materials ability to dry then the building material will begin to accumulate moisture and decay will occur. If the moisture content of building materials increases and is sustained at over 22% fungal decay is inevitable. Studies have shown, however, that mold can grow on wood with moisture content levels above 15% to18%.

It is also important to be aware that many of the engineered wood products like OSB rely on resins and glues to hold the wood, fibers, flakes or strands together and therefore are much more sensitive to moisture damage than dimensional lumber and plywood. They are prone to decay faster as well as have dimensional stability issues when wet. Engineered wood products can perform well and be good solutions but they require a higher level of protection from moisture.

Common Causes of Failures

Most water related building failures are caused by:

1. Poor architectural design that traps or directs water back into building assemblies and does not allow sufficient drainage.

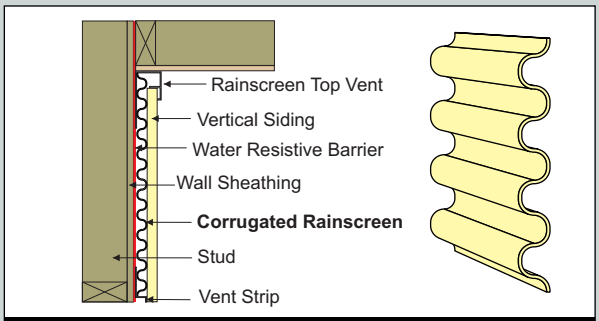
2. Failure to detail a well thought out moisture management plan and specifying the wrong materials for a given application.
3. Poor workmanship and substandard construction practices.
4. Moisture generation from occupants and lack of maintenance.

Building components get wet and damaged by:

1. **Wind and gravity driven rainwater** through leaks in the building envelope. ***Solution***: Proper installation of a high quality, drainable, weather resistive barrier, and flashing systems that promote proper drainage to the exterior.

Rainscreen of pressure treated lumber with drainable housewrap behind, as a best practice allowing lumber to dry and absorbed water to wick out and drain

2. **Capillary action**, water being absorbed from surrounding wet materials or conditions. ***Solution***: Avoid having reservoir cladding systems, stone stucco, and wood in direct contact with materials that can absorb and store water. Utilize a rain screen to create an air space that creates capillary break to stop capillary moisture flow. Using a drainable housewrap can also help reduce the impact of capillary moisture because it facilitates faster more efficient drainage of water.



A manufactured rainscreen system made from automotive plastic whose shape allows for cross ventilation and as a plastic is non-absorbative.

3. **Air movement of moisture-laden air** in and out of the envelope. Air contains moisture and as the air infiltrates or exfiltrates through building assemblies it can dampen building materials and even condense on cold surfaces leading to mold and decay. ***Solution***: Properly install a continuous air barrier system that consists of a breathable building wrap on the exterior and additional air sealing from the interior around all penetrations.

4. **Moisture flow by diffusion**. Diffusion is moisture flow as vapor from a higher humidity, environment to a lower humidity environment. This is a process where moisture is absorbed by building materials and then the moisture is released to a dryer environment. An example of moisture flow by diffusion is the drying process that would take place if the wall sheathing was damp and the moisture would diffuse or evaporate through a vapor permeable housewrap. ***Solution***: In colder climates install the proper class of vapor retarder for the matching climate zone as required by codes.

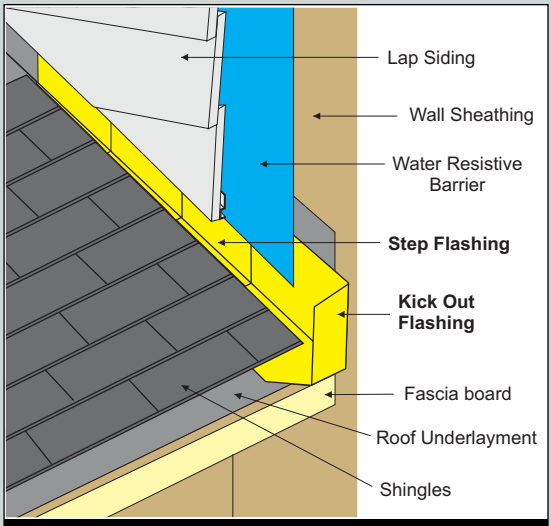
Designing a Moisture Management System

The key to building durable structures is more than just applying building paper or a housewrap. It's about employing tried and proven water management principles to develop a moisture management system that addresses all the mechanisms of moisture movement. It is a guide for architectural design, product selection and construction practice. Preventing moisture damage and call backs is really about implementing a system to effectively control moisture as a liquid and as a vapor.

Below is a checklist of components of a high performance moisture management system.

1. Weather resistive barriers, (WRB's), Drainable WRB's (best practice) and for maximum protection utilize rain screen systems. (best practice)

2. Step and Kick-out flashings at roof wall intersections



Proper installation of water managed system

3. Adhered flashing systems for windows, doors and all penetrations

4. Through-wall flashings at transition of dissimilar claddings

5. Through–wall flashing and a weep system at the base of wall for masonry/stucco claddings

Note weep holes & thru wall flashing

6. Prefabricated seamless flashing boots for roof penetrations

7. A continuous exterior air barrier system and interior air sealing

Home using a full water management system: drainable housewrap, flashing tape, double-sided seam tape, sealant providing water barrier and air barrier.

8. An interior vapor barrier as required by local codes

Kraft back insulation as vapor barrier

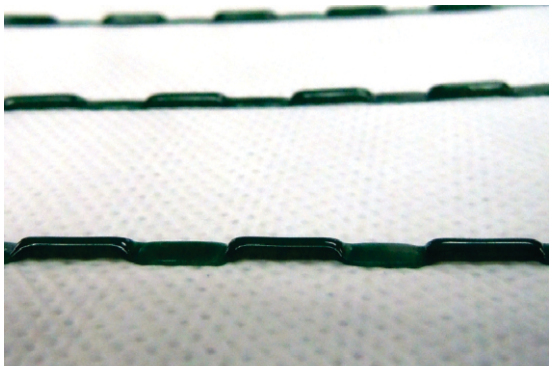
Controlling Rain Water

We control water by employing the four D's of water managed design, Deflection, Drainage, Drying and Durability. We control moisture as vapor movement with air and vapor barriers.

1. **Deflection**: This means utilizing designs, assemblies and products that deflect rain water away from the building. Fact: A one-inch rain will deposit over 600 gallons of water per 1000 square feet of roof. Designing to deflect this water away as fast as possible means that there will be less water for a building assembly to have to drain away. **Strategies include**: Avoiding complex, drain-less designs. Design roofs that slope away for fast and easy drainage, no horizontal valleys or surfaces. Utilize seamless kick–out flashings to divert roof water away from roof wall intersections.

Avoid horizontal valley that drain poorly

2. **Drainage**: All cladding systems can leak and will allow water penetration. The faster water can drain from a building assembly the less water that can be absorbed by building materials. Fast, efficient drainage reduces the amount of time needed for drying because components are less wet. This means less chance for fungal decay. The key here is to provide as much unrestricted drainage as possible.



Drainable housewrap utilizing a 1.5mm non-compressible filament to provide drainage gap between cladding and non-woven substrate.

Eliminate reverse shingling of building wraps and flashings that trap and divert water to the inside. **Strategies include**: Employing drainable housewraps, rain screen walls, adhesive flashings, through wall flashings at cladding transitions and though wall flashings and weep holes at the base of masonry walls.

Note that the building wrap is reversed shingled behind the metal flashing

3. **Drying**: Create a design and construction assembly that is conducive to building assembly drying. The above-mentioned deflection and drainage reduce the amount of water absorbed by building materials and therefore reduce the drying time. Since all cladding systems can leak the underlying building materials can get wet. The resulting damage potential is a function of how quickly wet building materials can drain and dry out. **Strategies for enhanced drying** : A good drainable weather resistive barrier (WRB) or building wrap will have a balance of properties that will prevent water intrusion but will ALSO be breathable enough to allow damp building materials to dry out should water ever get behind the wrap.

4. **Durability**: Specifying quality construction materials that are designed to last the life of the building is crucial to preventing moisture related call-backs long term. According the most recent US census (2009) 50% of all homes in America are over 40 years old and the average age of US homes is 36 years. Since building wraps, rain screens, flashings and sealants are a primary line of defense against moisture problems it is critical that all these components last and adhere for the life of the building which could easily be 75 to 100 years.

Weather Resistive Barriers (WRB's)

Building codes require WRB's under all cladding systems to prevent water penetration into building assemblies. WRB's can be as simple as building paper or as be as multifaceted as a high performance drainage wrap. Generally they are a synthetic sheeting material made in a variety of materials and configurations.

The function of a WRB or building wrap is to:

1. Create a weather barrier behind exterior cladding to protect the sheathing and aid in reducing water intrusion into the wall cavities.
   TamlynWrap™ passes a 55cm hydrostatic head test for water resistance with no water leakage on weathered and non-weathered samples.

2. Promote fast and efficient drainage of water out of the assembly.
   TamlynWrap™ has a drainage efficiency of 96%, resulting in 100x the bulk water removal versus standard housewraps and 2x the speed of other drainable housewraps.

3. Provide a vapor-permeable membrane that allows moisture trapped in sheathing to escape.
   TamlynWrap™ has a perm rating of 19, falling within the range that the building industry is trending towards with best being from 10-20 perms

4. Be an energy-efficient air barrier to stop air infiltration and exfiltration through walls in the home.
   TamlynWrap™ has 0.0018 L/(sm²) air resistance and we have created XtremeSeam™ Tape as a double-sided tape allowing for a better seal without compromising shingle fashion install and coupled with our XtremeSealant™ provides a high quality air barrier system.

Codes also require that WRB's be breathable. Building materials dry by a process of diffusion or the ability of moisture evaporate from a building material to the atmosphere. A vapor permeable or breathable WRB allows moisture vapor to escape thus reducing the drying time of damp building components.

The term permeability refers to the rate at which moisture vapor can pass through a material. WRB's need to be vapor permeable, which is defined as 10 perms or greater. (Building Science Corporation) Building codes however only require that WRB's meet or exceed grade D building paper which is 5 perms. What is not commonly known is that building papers permeability goes up when it gets wet and synthetics wraps do not. So 5-7perm synthetics wraps can actually have a lower permeability than building paper under damp conditions.

Moisture vapor, or water droplets in a vaporous form, are very small and invisible. Water as a liquid is cohesive and naturally wants to clump together thus takes up a larger space. WRB's are water resistant because the pores (spaces) in the sheet material are too small for liquid water to pass. WRB's have the ability to breathe because they are constructed with pores that are large enough to allow moisture as a vapor to pass through but too small for water as a liquid to pass. WRB's need to be breathable to allow interior moisture to escape and to allow for drying if the building assembly gets wet from rain water intrusion. The advantage of a wrap product over building paper is that it is more breathable, more durable and you can easily tape the seams to create a continuous water and air barrier system.

Air Barriers

Air barriers are used to control air infiltration and air exfiltration. Air barriers save energy and reduce the potential for moisture problems. Air leakage in buildings pushes out conditioned air requiring additional energy to re-heat or cool the air. A typical home has over ½ mile of cracks and gaps. Air barriers help save energy by reducing the buildings air exchange rate. Properly installed wraps can save between 15 and 20% on space conditioning costs.

Air barriers are also an important element in managing moisture. Air contains moisture and when moisture vapor comes in contact with cold building materials it can be absorbed by those materials and even condense. This increases the moisture content of building materials, which can lead to mold, and fungal decay. Air barriers reduce the flow of moisture-laden air in and out of structures thus reducing the potential for moisture accumulation. If exterior weather resistive barriers (WRB's) are breathable and non-perforated, they can double as a continuous air barrier.

Code required air barriers consist of:

1. Breathable building wraps

2. Interior air sealing of penetrations and gaps with foam and sealants

Spray foam sealed penetrations

Vapor Barriers/ Retarders

Do not confuse building wraps (WRB's) with vapor barrier/retarders. Vapor barriers and vapor retarders, are required by codes in the colder climates zones. They are installed on the warm side of the insulation. The original intent was to prevent moisture laden air from conditioned living spaces from diffusing through the wall finishes and insulation and then condensing in wall cavities on cold surfaces. The reality is that under normal circumstances there is not much moisture flow by diffusion. Since vapor barriers and retarders are typically not sealed, and are installed with many gaps and voids they are often not very effective at preventing moisture vapor from entering wall cavities. The primary mover of moisture into wall cavities is air exfiltration. Many building science experts believe that vapor barriers cause more problems than they solve because they reduce drying potential to the inside and trap moisture. Unlike vapor retarders WRB's are vapor permeable which means that moisture can readily diffuse through the wrap and allow wet building assemblies to dry. Vapor barriers and retarders allow no or very little moisture vapor to pass through.

There are three classes of vapor barriers and retarders and they range in permeability. Different climate conditions require a specific class of vapor retarder.

- Class I Vapor Retarder (vapor barrier): less than or equal to 0.1 perms
- Class II Vapor Retarder: less than or equal to 1 perm and greater than 0.1 perms
- Vapor III Vapor Retarder: greater than 1 perm but less than 10 perms

Selecting Building Wrap

There are dozens of building wrap products available today. There are wide variations in performance and cost. Most house wraps are made from polyethylene or polypropylene plastic.

Types of housewraps

- Perforated, woven film
- Films laminated to spunbond nonwovens
- Films laminated or coated to polypropylene
- Spunbonded nonwovens
- Drainable housewraps

Properties to look for when buying a housewrap

- Water resistance
- Drainage efficiency
- Water vapor transmission or breathability
- Ability to impede air flow
- Durability and tear resistance
- Flammability smoked developed
- Cold weather flexibility

The International Codes Council (ICC) has a an acceptance criteria ICC-ES AC38.

AC38 establishes guidelines for evaluation of water-resistive barriers, (WRBs) which are limited to sheet materials used on exterior walls as water-resistive barriers; moisture protection barriers; weather-resistive barriers; and (optionally) air barrier materials. This acceptance criteria is designed to give the industry a list of tests that best evaluate the necessary performance factors required of a building wrap. These tests are helpful in comparing products.

Water Resistance – the test for this is AATCC Test Method 127: Hydrostatic Pressure Test. During this test three control specimens and three specimens that have been weathered via UV/acceleration; are placed under a hydrostatic head of 55 cm for 5 hours. **All of the TamlynWrap™ specimens were observed to have no water leakage, meaning that all met the water resistance requirement of AC38.**

Drainage Efficiency – the test for this is ASTM E2273. During this test a wall assembly was created with TamlynWrap™ over the sheathing behind the cladding and water was applied to the assembly with the amount of drainage over time recorded. **AC38 minimum is ≥90% with TamlynWrap™ achieving 96%.**

Water Vapor Transmission – the test for this is ASTM E96 Desiccant Method. During this test the specimens were spread across a test dish with one side containing a desiccant (a material that absorbs moisture vapor), then placed in temperature and relative humidity controlled environment with periodic weighs determining the rate of water vapor movement. **AC38 minimum is 5 perms but the building industry trend is 10-20 perms which TamlynWrap™ falls within at 19 perms.**

Ability to impede air flow – the test for this is ASTM E2178 Air Permeance of Building Materials. During this test TamlynWrap™ is sealed with polyethylene sheeting and tested with preset air pressure, then the polyethylene sheeting is removed and the variation gives the air permeance. **The maximum allowed by AC38 is 0.02 L/(sm²) and TamlynWrap™ is at 0.0018 L/(sm²)**

Durability and tear resistance – the test for this is ASTM D5034 Breaking Strength and Elongation of Textile Fabric. During this test TamlynWrap™ is put under a constant rate of extension till breakage. **The minimum for AC38 is 35 lb CD and 40 lb MD with TamlynWrap™ greatly exceeding these (52 lb CD and 60 lb MD) in part because of its continuous filament.**

Cold weather flexibility – During this test a specimen of TamlynWrap™ is conditioned to 32°F (0°C) then bent over a 1/16" diameter mandrel, and to pass it must not crack which TamlynWrap™ didn't.

Flammability and smoke developed – the test for this is ASTM E84 Surface Burning Characteristics of Building Materials. During this test TamlynWrap™ is placed in a tunnel with a burner on one end and a draft facilitates flame progression with the spread being calculated. **TamlynWrap™ qualified for Class A with a flame spread index (0 – 25) of 10 and smoke developed index of 115.**

The New Standard in Housewrap

TamlynWrap™

Drainable Housewrap

TamlynWrap™ Drainable Housewrap is the newest moisture management product from Tamlyn. This innovative product effectively eliminates excess moisture and mitigates the damaging effects of mold and rot. Its unique design removes at least 100 times more bulk water from a wall versus standard housewraps. This is achieved through the gap created by 1.5 mm spacers bonded to a high performance housewrap. This patented gap design provides a true drainage space between the sheathing and cladding material.

For more information
visit www.TamlynWrap.com
or call us at (800) 334-1676

"When Doing It Right Matters"