Understanding Housewraps:

A Decision Guide for Selecting the Right Housewrap

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Understanding Housewraps

When discussing moisture management solutions in the building industry, it's important to recognize and accept one simple and indisputable reality: *water gets into buildings.*

INTRODUCTION

Building scientists and other experts agree: no matter how tightly a building is constructed, no matter how well it's insulated, no matter what type of exterior cladding is chosen and how expertly it's installed, moisture will *always* find a way into the building enclosure. Moisture infiltration can undermine structural integrity, cause exterior surfaces to deteriorate, and shorten life of paints and stains. It can also foster mold and rot that not only cause structural damage but also pose serious health hazards.

Ridding the wall assembly of liquid water and water vapor as quickly as possible (before it can damage structural components) is what moisture management is all about.

There are many moisture management products currently on the market, including traditional felt paper, rainscreen systems, caulks, sealants, and self-adhered flashing membranes. Choices are expanding, driven by advances in technology, evolving building codes, growing customer concern with mold prevention, and many other factors.

Each of the aforementioned moisture management products has its place, depending upon local environmental conditions and project details. Increasingly, synthetic housewraps are being viewed as an essential component of a well-designed, well-constructed low-rise building in virtually any environment. This White Paper defines housewrap and explains why it is needed. It also covers the different types of housewrap that are available and their respective features.

How does water get in?

How does moisture infiltrate a wall? High humidity and extreme temperatures can cause vapor diffusion, with moisture flowing from warm to cold (transported by air movement through leaks/penetrations in the assembly) and condensing on the colder surface. Wind-driven rain can be forced into small openings in the exterior cladding at joints, laps, utility cut-outs, electrical outlets, nail holes, etc. Wind blowing around the building can create a negative pressure within the wall assembly which siphons water into the wall. Some "reservoir" claddings, such as brick, stone and stucco, can absorb and store moisture which the sun then drives into the wall assembly (solar drive).

Exterior cladding usually is considered to be the primary barrier to water entering a building enclosure, but no cladding can keep out all water. Siding expands and contracts, creating gaps in the exterior surface of the building. Intersections, joints, and wall penetrations are all susceptible to infiltration. Brick, stone and stucco are porous; therefore, they absorb moisture. Behind the exterior finish, every home should ideally have a drainage plane, a mechanism that redirects any bulk water that penetrates the exterior finish down and away from the home's wall assembly. This second level of protection, specifically designed to resist and eliminate moisture, is the job of housewraps.

WHAT IS HOUSEWRAP?

Housewrap generally refers to synthetic sheeting that is wrapped around a house to protect against moisture infiltration. Like building paper or a fluid-applied barrier, housewrap is a water-resistive barrier (WRB), and, like all WRBs, it has one primary function: resisting the infiltration of water into a building assembly.

Plastic housewraps entered into the building arena in the 1970s, prior to which asphalt saturated kraft paper or asphalt saturated felt were the predominant form of WRB. Housewraps have become increasingly popular for their ease of installation, durability, and ability to block water that has penetrated the exterior cladding from moving further into the wall assembly. Installed behind siding, housewrap prevents wind-driven rain and water from reaching the sheathing and framing, and prevents air infiltration, helping to reduce heating and cooling costs.

In addition to resisting initial moisture infiltration, housewraps go a step farther by helping to *remove* trapped moisture from the building enclosure. Housewraps provide a vapor-permeable layer that resists liquid water from the outside, while also allowing water vapor to escape the assembly, enabling the wall to "breathe" (for example, if water vapor is driven from the interior to the exterior during a heating season, the housewrap will allow the vapor to escape).

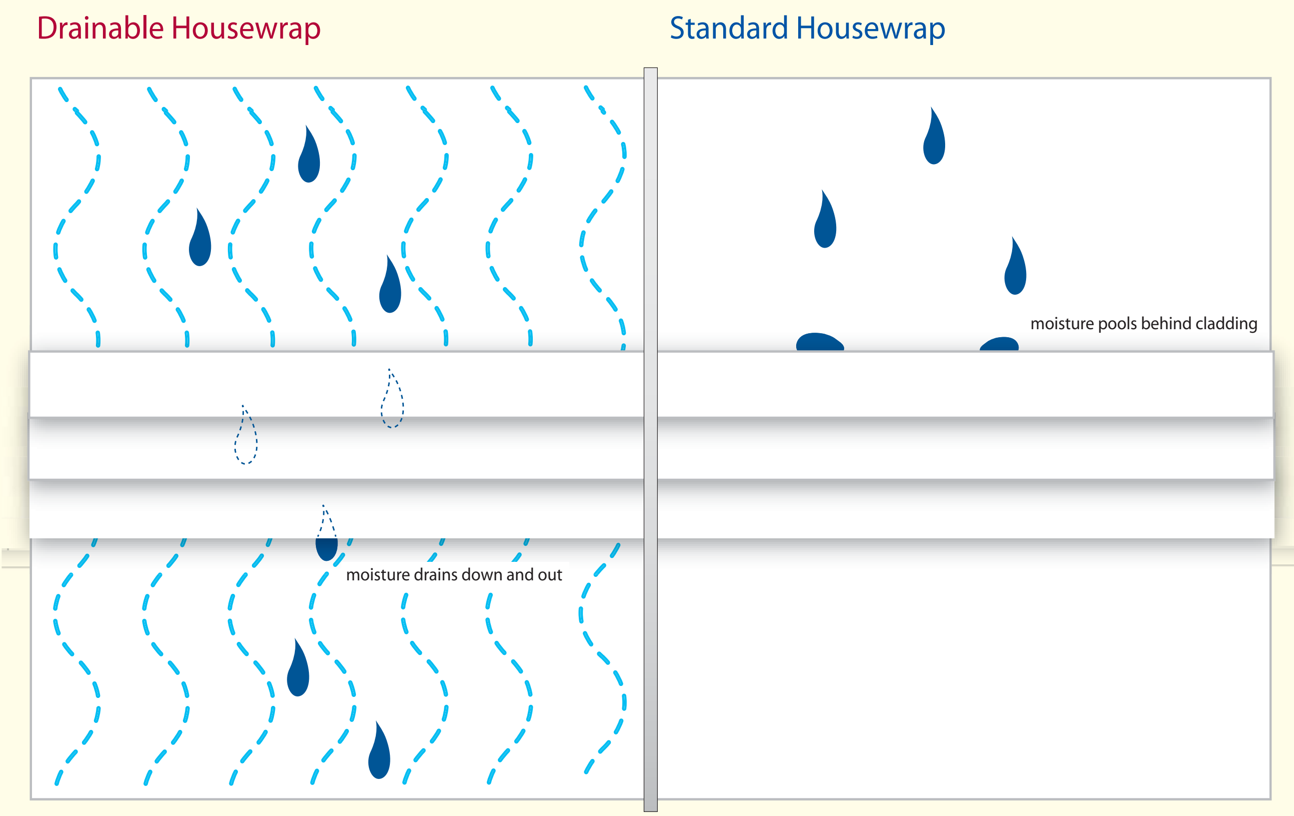
The function of all housewrap:

1. To create a weather barrier behind exterior cladding while protecting the sheathing
2. To provide a vapor-permeable membrane that allows moisture trapped in sheathing to escape
3. To be an energy-efficient air barrier to stop air infiltration into the home

A New Generation of Housewrap

There is growing recognition among building scientists and building codes that walls also need to *drain*, and, going forward, housewraps will increasingly be judged by how effectively they provide positive drainage of water from the wall.

Drainable housewraps, the fastest-growing segment of the market, address this need by incorporating both a water-resistive layer and a drainage gap, greatly facilitating water drainage from behind the exterior cladding system. Unlike typical housewraps, which provide only a water-resistive layer and can trap water behind cladding, drainable housewraps provide a continuous drainage gap that allows water to quickly escape from the wall system, protecting the building enclosure. These enhanced products provide a much higher and more constant drain rate than standard housewraps. Compared to standard housewraps, the newest drainable housewraps – especially those that provide a minimum of a one (1mm) millimeter gap – can be as much as 100 times more effective at removing bulk water from the wall.



The difference between water-resistive barriers like housewrap and building paper (shown at right) and drainable housewrap (left) is the additional gap created by spacers, which allows moisture to drain from wall assemblies at a faster rate. In addition, the drainage channels form an unobstructed path behind cladding, avoiding the possibility of "ponding" along siding edges with traditional barriers.

Some housewraps marketed for their drainable features are engineered with vertical grooves to promote drainage.

One drainable housewrap is designed with a spacer design to create a 1mm drainage gap that drains moisture faster than similar wraps.

The drainable building wrap shown features drainage channels designed not to crimp or collapse when cladding is applied, according to the manufacturer.

This drainage barrier wrap features an embossed surface that creates an airspace for moisture drainage.

Selecting the Right Housewrap

Housewraps are now available in dozens of varieties. Most are nonwoven or woven plastic fabrics made from either polyethylene or polypropylene. Some have micro-perforations to let water vapor pass through and the others are designed to let water vapor diffuse through the fabric itself (micro-porous).

So how do you choose? One good place to start is a set of performance criteria recognized by the International Code Council Evaluation Service (ICC-ES), which evaluates building products (including housewraps) and provides opinions on code compliance (see chart on page 8). For housewraps, the ICC-ES evaluates a variety of key characteristics including:

Water Resistance: As its most basic function, a housewrap must hold out liquid water. ICC-ES allows for three different testing standards, and a quick overview of the protocols may help in better understanding manufacturers' published specs. The "Boat Test," developed for paper and felt, is the least stringent standard. It is overly sensitive to humidity and vapor transfer; therefore, it's unreliable for plastic housewraps. Better approaches are the "Water Ponding" or "Hydrostatic Pressure" tests. Water Ponding is a measure of a housewrap's resistance to a "pond" of 1 inch water over two hours. Hydrostatic Pressure, the most stringent test, exerts significant pressures on a housewrap sample through a column of water (55 cm or higher). A premium housewrap should be able to pass both of the aforementioned tests.

Durability: A housewrap must be able to withstand the handling and application process without compromising its water-resistance performance. The tear resistance, or tensile strength of the product, is the best available indicator of whether or not a housewrap might be damaged. UV and cold resistance are also tested for housewraps. UV resistance depends on the time between the installation of the housewrap and the application of the siding. Many housewraps provide a 90 – 180 day recommendation for installation of siding; however, in most cases housewrap should be covered within 30 days if possible. The cold resistance test standard is to ensure that housewraps do not start to crack at low temperatures.

Vapor Permeability: Permeability measures the amount of vapor transmission that a housewrap will allow over a period of time, minimizing the potential for accumulation of moisture vapor. The higher the "perm number," the more vapor permeable the material. There is debate on the optimal permeance range for housewraps, with 10 – 20 perms considered by some to be a "sweet spot."

Although grounded in building science, the debate over appropriate vapor transmission often focuses too much on the perm number. In reality, the permeability of a housewrap varies from lab conditions to installed conditions (particularly after the housewrap is fastened on a wall). For a product to be considered a housewrap (and not a vapor retarder), the permeance rating must be higher than 5. But a higher perm rating doesn't guarantee a better housewrap. Housewraps with mechanical micro-perforations may allow the passage of more water vapor, but they also make the housewrap vulnerable to bulk water leakage. Other housewraps with high permeability may allow moisture that is stored in reservoir cladding to be driven into the sheathing and insulation through solar drive.

Air Resistance: An air barrier is a continuous system that stops the unintended movement of air across the building enclosure. Most housewraps are tested for their resistance to air movement, but the ICC-ES standard does not account for seams and penetrations. Therefore, air resistance is not a critical product selection criteria since real-world performance depends very much on installation conditions.

Drainage: Drainage is widely accepted as one of the most effective measures for reducing moisture damage due to rain penetration. Drainage is a critical component in allowing the housewrap to do its job – particularly in keeping walls dry. According to a study by John Straube and Jonathan Smegal of Building Science Corporation, a 1mm drainage gap "will drain water at a rate considerably greater than rainwater is expected to penetrate behind cladding even in extreme conditions." A 1mm gap between the housewrap and the cladding provided a "measured drainage rate in excess of 1.1 liters/ minute-meter, more than the extreme driving rain intensity of the worst climate in Canada."[1] Manufacturers are now focusing on housewrap products that are designed to provide an integrated gap and drainage plane.

[1] (Modeled and Measured Drainage, Storage, and Drying behind Cladding Systems: Research Report – 0905)

Other important product attributes to consider

While it's important to understand the published performance characteristics of a housewrap (as measured by testing), performance testing does not always tell the whole story, and additional questions must also be addressed in the selection of a housewrap.

Does the housewrap resist surfactants?

Surfactants (surface active agents) reduce the surface tension of a liquid so it can penetrate deeper into a material. In the building industry, surfactants occur naturally in materials such as cedar, stucco and stone mixes (or in the mixtures used to power wash houses). Water that manages to get into a building system carries these surfactants and allows them to penetrate deeper into the walls. A housewrap can eventually lose its repellency and allow water to soak through to underlying sheathing, etc. Some housewraps are specifically designed with coatings that resist surfactants. Drainable housewrap provides space to carry water away, mitigating surfactant-induced damage.

Is the housewrap drainable or non-drainable?

All housewraps are designed to "drain" since they repel water, but as with any product, that depends on the installation conditions. When siding is applied tightly against the housewrap, insufficient space is created for drainage. Therefore, some drainable housewraps utilize creping, embossing, weaving, or filament spacers to provide a gap for drainage.

Is the housewrap perforated or non-perforated?

Housewrap needs to provide holes big enough to allow vapor to pass, yet small enough to prevent liquid water from penetrating. The micro-perforated approach facilitates vapor migration, but reduces the water resistance of the final product. Non-perforated or micro-porous products allow for sufficient vapor migration while providing excellent resistance to bulk water.

Is the housewrap woven or non-woven?

While a woven fabric itself is not necessarily a concern, many woven housewraps are also micro-perforated, which compromises water resistance.

Additional Factors to Consider

Cladding Type: It's been widely reported that reservoir claddings such as brick, stucco, and stone all pose serious concerns for water entry into a wall assembly. Therefore, walls should be built with an air space behind these claddings. But the concern doesn't only apply to reservoir claddings; any siding installed tightly to a wall, including fiber cement, insulated vinyl, and wood, has the potential to hold trapped moisture. A build-up of water between the siding and housewrap can create significant hydrostatic pressures that drive moisture further into the framing materials. Type of cladding alone cannot determine when a standard housewrap, drainable housewrap, or rainscreen would be most appropriate, but consider the following to help in the decision process.

Climate: The amount of annual rainfall can be used as a guide for determining the level of moisture management needed in a wall. As a rule of thumb, the Building Enclosure Moisture Management Institute recommends that "any area receiving more than 20 inches of annual rainfall should incorporate enhanced drainage techniques in the wall system, especially if using an absorptive cladding material. Areas receiving 40" or more of rainfall should utilize rainscreen design regardless of cladding material." With that said, only one rain event is needed to introduce water into a wall assembly. And without adequate drainage, trapped moisture can pose a risk even in dry climates.

Wall Assembly (Tightness): In general, the more air-tight and insulated a wall assembly, the lower its drying potential. A wall with a relatively low drying potential must incorporate effective moisture management techniques. If water gets in, a wall designed to drain allows it to get out.

Exposure: Additional factors such as geographic orientation of the wall, amount of overhang, altitude, and even trees and buildings in proximity will help contribute to a more knowledgeable design decision. That information will help in understanding the potential for wind pressure, wetting, and drying, and, therefore, what level of moisture management to incorporate into a wall.

Glossary of Terms

Housewraps, WRBs, Rainscreens
When it comes to how to select the right moisture management solution for each job, the first challenge is navigating through some potentially confusing terminology. Product names such as housewraps, building paper, and rainscreens are frequently used interchangeably, when in fact they can play distinctly different roles.

A Water-Resistive Barrier (WRB) – Sometimes referred to as a weather resistant barrier, is a material that repels water and is installed behind the cladding as a secondary barrier and interconnected with flashings, window and door openings, or other penetrations of the building enclosure. There are many types of WRBs including:

Housewrap – Plastic rolled sheeting designed to resist air and liquid water, while allowing some passage of water vapor. Strength and integrity is provided by a woven or non-woven fabric. Water and air resistance is achieved by fiber spun technology or the incorporation of a film layer. Vapor breathability is achieved through fiber pore size, micro-porous films, or mechanical micro-perforations.

Drainable Housewrap – With an added feature of a built-in drainage gap, these products combine the benefits of standard housewrap with enhanced water-shedding capability.

Building Paper (asphalt-saturated kraft paper) – Rolled material consisting of single layer of mostly virgin cellulose fibers saturated with asphalt.

Felt (asphalt-saturated felt) – Rolled material with multiple layers of loosely laid recycled cellulose fibers saturated with asphalt. Tends to be heavier and more brittle than paper, but provides a varying vapor permeance depending on exposure to moisture.

Pre-weatherized Sheathing – Sheathing product that is factory modified to provide the performance characteristics of a WRB.

Fluid-Applied WRB – Spray, rolled, or trowel applied membrane that upon curing provides the WRB performance characteristics.

Self-Adhered WRB – Rollable polymeric sheet coated on one side with adhesive, which allows the product to stick to the wall.

Combination WRB/Rainscreen Products – Typically a housewrap pre-attached with a rainscreen. Unlike a drainable housewrap, these products provide a full capillary break and enhanced ventilation drying in addition to the water-resistive barrier properties of a housewrap.

Rainscreen – A rainscreen controls rain entry by locating a 1/4 – to – 3/4-inch pressure-moderated air space immediately behind the exterior cladding in addition to employing a water resistive barrier. A rainscreen system is recommended when drainage and ventilation are necessary for maximum wall-drying potential, typically when installing moisture-absorptive claddings in areas with frequent wind driven rain. For guidelines on when and where to use a rainscreen, refer to Benjamin Obdyke's White Paper "Managing Moisture in Low-Rise Building Enclosures" found at www.benjaminobdyke.com.

ICC-ES (International Code Council Evaluation Service)
AC38 Housewrap Performance Criteria

Characteristic Evaluated		Test Method	Minimum Performance Requirement
Durability	Strength	ASTM D5034: Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Method) ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting	>40lbf MD, 35lbf CD >20lbf MD, 20lbf CD
	Weathering	UV Exposure/Accelerated-Aging	Weathered samples pass strength and water resistance
	Cold Resistance	AC38 Section 3.3.4: Cold Mandrel Bend Test	No cracking
Water Resistance	Boat Test	ASTM D779: Standard Test Method for Water-Resistance of Paper, Paperboard and Other Sheet Materials by the Dry Indicator Method	10 minutes - no water passage
	Water-Ponding Test	CCMC 07102 (Section 6.4.5): Water-Ponding Test	2 hours - no water passage
	Static & Dynamic Water Pressure Resistance	AATCC Test Method 127: Water Resistance Hydrostatic Pressure Test	5 hours - no water passage
Permeability	Water Vapor Transmission	ASTM E96: Test Method for Water Vapor Transmission of Materials	>5 US Perms
Air Resistance (optional)	Air-Barrier Resistance	ASTM E2178: Standard Test Method for Air Permeability of Building Materials	<0.02 L/SM^2@75 psi [.004 CFM/FT.^{2}@1.57 psi
Drainage (optional)	Drainage Efficiency	ASTM E2273: Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies	>90% drainage efficiency
Fire Resistance (optional)	Flame Spread Index and Smoke Development	ASTM E84: Test Method for Surface Burning Characteristics of Building Materials	Class A

Impact of Building Codes

Among the factors driving the need for better moisture management solutions are the continued growth and standardization of requirements such as the International Residential Code (IRC) and the International Building Code (IBC), which requires a means of draining water that enters the wall assembly.

The IRC now mandates the use of water-resistive barriers, stating that *"The exterior wall envelope shall be constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer…and a means of draining to the exterior water that enters the assembly (R703.1.1 Water Resistance)."*

Stucco and manufactured stone walls have an additional requirement regarding the draining of water that penetrates the exterior veneer: *"Water-Resistive Barriers…shall include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of Grade D Paper. Exception: [one layer may be used] where the water-resistive barrier is separated by the stucco by an intervening, substantially non-water absorbing layer or designed drainage space. (R703.6.3)"*

Where the codes are going

Some U.S. states have added even more prescriptive measures to their codes. Oregon, for example, now requires a means of drainage in wall assemblies, and other states are expected to follow. The Oregon code mandates that *"…the [building] envelope shall consist of an exterior veneer, a water-resistive barrier (housewrap, building paper, etc.) and a minimum 1/8" (3mm) space between the WRB and the exterior veneer. The required space should be formed by the use of any non-corrodible furring strip, drainage mat, or drainage board."* An exception to this is that *"a space is not required where the exterior veneer is installed over a water-resistive barrier complying with section R703.2 which is manufactured in a manner to enhance drainage and meets the 75% drainage efficiency requirement of ASTM E2273 or other recognized standards."*

Canada has always been ahead of the curve as it relates to moisture management. In coastal provinces of Canada, rainscreen systems are required:
"…exterior walls exposed to precipitation shall be protected against precipitation ingress by an exterior cladding assembly consisting of a first plane of protection and a second plane of protection incorporating a capillary break (a drained and vented air space between the cladding and the backing assembly, over the full height of the wall…)"

Installation is Key

No housewrap on the market will do its intended job if it isn't carefully and properly installed.

The time between installation of the housewrap and the addition of exterior cladding should be kept to a minimum. Housewrap that is exposed to the elements for longer than its intended UV rating can deteriorate. Lengthy exposure can also result in tears and holes that can affect performance if not repaired.

Wrapping should start at the foundation, extending at least an inch past the wall-to-foundation intersection. It should continue upwards like shingle installation, with the higher course overlapping the lower course. According to code, all horizontal seams should be overlapped a minimum of 2 inch, and vertical seams a minimum of 6 inch.

Finally, the manufacturer-recommended tape should be used to cover tears and holes. Common galvanized roofing nails or plastic cap nails may be used for attachment of the housewrap. Staples can cause tears and should be used with caution when installing a standard housewrap.

To tape or not to tape

A key decision in installing any housewrap is whether or not to use seaming tape and cap fasteners. One primary factor in this decision is whether the housewrap is being used to resist water entry *and* reduce air infiltration.

In a well-constructed wall assembly, there is little evidence that a layer of housewrap will significantly tighten the building against air infiltration.[2] In general, air-sealing efforts are better spent on the building's interior, using drywall and framing, or a continuous air barrier material, along with caulks and gaskets.

Using a housewrap to provide a true exterior air barrier system is a very difficult and complex proposition. Cap fasteners must be used to install the housewrap, and all joints, openings and penetrations must be carefully taped and sealed. The bottom course of housewrap must be sealed to the foundation or sill plate, and the top course of housewrap sealed to the sheathing or top plate.

[2] InspectApedia: Free Encyclopedia of Building Environmental Testing, Diagnosis,Repair http://www.inspectapedia.com/BestPractices/Sheathing_Wrap.htm)

If the primary purpose of the housewrap is to serve as a moisture barrier, introduction of a drainage gap into the wall assembly can reduce the need for tape and cap fasteners, with significant savings in time and money.

Most manufacturers recommend taping all seams (both vertical and horizontal) as a rule of thumb for any installation. However, the use of tape is not usually a building code requirement, and taping can add as much as 15% to installation costs. Additionally, the durability of the tape (or how long it will stay fully adhered) is always a question. Tape holds its value in its ability to maintain the integrity of the installation during the exposure time, before the cladding is applied. Because of this, the need for tape depends largely on: a) the severity of a given site's environmental conditions, and b) exposure time. Some builders believe vertical taping can reduce horizontal or lateral migration of water across the wall. But with the use of a drainage gap in the wall (and proper overlap of the housewrap) water will naturally flow downward (direction of least resistance) and drain out of the assembly, as required. In addition, taping horizontal seams creates a negative overlap. Therefore if not sealed properly, the tape can trap moisture that would otherwise drain down and out of the wall. All of these factors make taping a questionable value proposition.

As mentioned above, cap-fasteners are a requirement if the primary purpose of the housewrap is to function as an air barrier system. However, the primary value of cap-fasteners is to stop moisture from migrating through the fastener holes. With a housewrap solution that provides a drainage gap, the driving forces of migration through fastener holes (such as hydrostatic pressure) are reduced, and the value of caps is significantly lessened.

CONCLUSION

Building scientists continue to study the risks associated with the migration of moisture into structures. National and state building codes are evolving to address the need for moisture management in building construction. Building owners are becoming more educated and concerned about moisture-related issues such as mold, rot and insect infestation that affect a building's durability.

Advances in building construction and technology have vastly broadened the range of solutions for effective moisture management.

Selection of the right solution remains a complex issue, with necessary considerations given to environments, the type of exterior cladding that will be used, and project budgets and timetables.

Housewraps, especially drainable housewraps with enhanced drainage capabilities engineered into them, are increasingly being viewed as essential components of any well-constructed building.

Choosing the right housewrap requires an understanding of the product's key attributes, including Water Resistance, Durability, Vapor Permeability and Drainage.

Architects, builders and buyers must understand and appreciate the differences between perforated and non-perforated, and woven vs. non-woven housewrap products. More importantly, these parties must also understand the differences between traditional housewraps and the next-generation drainable products that will provide enhanced moisture protection at a cost-effective price.

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For more information about our line of moisture management products, including HydroGap™ Drainable Housewrap, call 800.346.7655 or visit www.benjaminobdyke.com.

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