Traditional building methods have evolved slowly over many centuries in response to the strengths and weaknesses of available materials. During the past hundred years, building techniques have evolved with increasing rapidity in response to the creation of new technology, development of new materials, changes to model building codes, and higher expectations for building comfort and performance.

Newer cladding materials like vinyl siding, aluminum siding, and EIFS promised high performance and lower construction costs. These new materials did not have the same development history as traditional materials. Designers specifying and detailing new systems did not fully examine and address the weaknesses of those new systems. Often, they failed to avoid chemical incompatibilities between different materials used in new envelope systems. Workmen installing new systems were not trained to understand their new requirements. They frequently applied the same techniques they had used for more traditional cladding systems and installed the new materials incorrectly.

The lifespan of each component used to construct these new envelope systems varies, placing a higher burden of more complex maintenance requirements on building owners and maintenance staffs. A drainage system like traditional shingles or siding will reliably resist the elements for many years with minimal maintenance. In a wet, windy climate, these types of cladding will require paint approximately every decade. While they benefit from yearly inspection and repairs, they will not require replacement for many decades if properly designed and installed and if kept painted or stained.

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An evolution in building envelope construction

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Proper design and construction will result in a building that can adequately resist predictable exposure to rain and wind without requiring an unreasonable level of maintenance. In the rainy parts of the Pacific Northwest, this entails that buildings must withstand long periods of rain, as well as rain driven by high winds, and they must be economical to remain weather resistant using available manpower and equipment. In this climate, building defects are a foreseeable consequence of material, design, construction, and maintenance failures.

In this climate, drainage systems like shingles and rainscreen are more reliable claddings than barrier systems that rely upon sealant joint maintenance to preserve their integrity. Over the past decade, building envelope construction has rapidly evolved toward the widespread use of rainscreen systems in mid-rise residential construction. Conceptually, rainscreen systems are an evolution of long tested techniques like shingles and lap siding, but with the addition of a drainage plane between the siding and an inner waterproof membrane.

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Sealant joints are sometimes used in traditional systems, but because modern high-tech materials had not been invented when these systems were developed, sealant maintenance is less critical in a properly designed and installed system. Newer systems, such as EIFS, attempted to take advantage of new materials. They promised to eliminate the need for paint and provide a more complete seal against the elements and better thermal performance. Their weakness is an inherent lack of an error margin for imperfections in materials, design, or workmanship. When a barrier system like EIFS is defective, water that penetrates the outer layer is trapped inside a building's wall cavity instead of draining back to the exterior. In order to maintain an adequately designed and installed barrier system, the owner or property manager must inspect sealant joints on an annual basis, repair damage from adhesive and cohesive failure, and utilize chemically compatible materials.
Access often requires articulated aerial lifts or suspended scaffolding and may require specially trained personnel. For these reasons, building owners often fail to adhere to periodic inspection schedules and minimum requirements necessary to properly maintain a weather-tight barrier system.

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Most cladding can be classified into three basic types: mass systems, barrier systems, and drainage systems. These systems evolved in response to climate, available materials, local skills, and economic pressures. The expected lifespan of materials used to install these systems directly impacts the amount of maintenance necessary to keep each building technique sound.

Mass systems rely upon water resistance provided by the thickness of exterior cladding materials. These materials are generally part of heavy bearing walls, like stone or masonry. The materials themselves are porous, but water penetration is limited to a portion of the thickness of the wall. Examples of this kind of building envelope include stone walled houses and barns, old mills, and other structures prevalent in the east that have exposed brick walls on both the interior and exterior, and carefully fitted log structures.

Mass systems are expensive to build and require careful maintenance at perimeter sealant joints around windows, doors, and other openings. Brick masonry requires periodic tuck pointing to maintain its structural integrity and weather resistance, and it does not resist seismic forces well without extensive internal reinforcement. Because the walls rely upon mass for both structural strength and weather resistance, buildings using mass systems are restricted to fewer and smaller window openings than buildings using other types of cladding. For these reasons, mass systems are not commonly used in modern mid-rise construction.

Barrier systems are generally less expensive to construct than mass systems, and are now used on buildings of a variety of sizes and configurations. Because the building skin is separate from the underlying structure, they rely upon a sealed skin to repel water. The seal depends upon a combination of waterproof siding materials and sealant joints. The building's skin must be continuous, and each sealant joint must be consistently maintained to avoid leaks. A barrier system relies upon a continuous seal, meaning that water penetrating the outer layer becomes trapped and creates interior damage by draining into the building.

Synthetic stuccos that are often used in barrier systems compound sealant problems because sealants do no adhere well to the mesh substrate, making joint failures more likely. Insulated metal sandwich panels have similar sealant joint issues. The steel skin of these panels expands and contracts in response to thermal changes, stressing perimeter sealant joints. Other types of barrier systems have similar problems wherever the building envelope has a joint between dissimilar materials, an opening, or a change in building plane. Additional problems that lead to failures in barrier systems include sealants that are incompatible with surrounding materials and differential thermal expansion and contraction.

The outer layer of drainage systems is not completely waterproof, but relies upon the ability of water to reliably migrate to the exterior instead of the interior when it penetrates the outer layer. Wood shingles demonstrate how this works: properly installed, each shingle overlaps the shingle below it and a portion of the shingle the second row below that. This provides a continuous path out of the wall cavity for water when it is driven through gaps between shingles. Shingled walls provide such sufficient ability to shed water that they rarely allow moisture past the shingled layer. In instances when water does penetrate, drainage systems built over the past century include a water resistant membrane behind the siding that permits water to exit before it damages the building.

Traditionally, this membrane was building felt, or tar paper. It is inexpensive and has a long and successful history of use, but increasingly restrictive energy codes have caused it to be superseded by synthetic materials like Tyvek (spun polyester) and Vaproshield (spun polypropylene). Drainage systems are more forgiving than barrier systems, but also rely upon competent design and skilled workmanship. If the membrane is installed incorrectly it will improperly channel water into the building, with foreseeable damage to the structure and finishes.

Rainscreen systems are the most reliable drainage systems developed to date and have gained widespread use over the past decade. Rainscreen takes the drained envelope one step farther and places a narrow plane between the siding and the water resistant membrane. This membrane can be the air barrier required by current energy regulations.

Rainscreen is more expensive than traditional drainage systems like shingles or lap siding because it adds vertical battens over the waterproof membrane, but it allows windows and trim to be weatherproofed without using high maintenance sealants. The battens provide drainage channels behind the outer layer of the building's cladding. In concept, rainscreen is similar to curtain wall construction, but is the outer skin rather than the entire wall.

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Joints within a rainscreen envelope require thoughtful design, competent construction, and appropriate maintenance, but they are less dependent upon unreliable maintenance and onerous inspection schedules. Exterior cladding using rainscreen technology can incorporate cement board, metal, stucco, wood or other outer siding materials. A building using closed joint rainscreen technology appears similar to a building built with traditional siding.

As recently as ten years ago, rainscreen was not universally accepted due to the cost increase associated with the added battens and other details it incorporates. A variety of hybrid systems were built in response to economic pressures and the problems inherent to barrier systems, including combination systems using synthetic stucco over traditional lath and building felt. These hybrid systems also incorporated a variety of flexible, adhesive flashings that are a component of current rainscreen systems. These developments were an evolutionary response to the problems inherent in barrier systems but did not fully address those problems. Hybrid systems are not as reliant upon sealants for weatherproofing as barrier systems, but because water that penetrates the surface cannot drain back out unless they are specifically designed and constructed with this in mind.

They are subject to unpredictable water infiltration damage and defects because they share many of their characteristics with barrier systems. Properly constructed, they are more reliable than barrier systems because they incorporate a secondary waterproofing membrane behind the outer skin, but defects caused by water penetration and lack of drainage are foreseeable in these systems.

Rainscreen cladding systems are the current practice for mid-rise buildings in the Pacific Northwest. Unlike barrier systems, they are not dependent upon sealant joints, but rely upon thoughtful design and competent installation in order to function properly. Each material used in the waterproof membrane must be compatible with adjacent materials, so it is critical to specify adhesives, membrane materials, and flexible flashings that do not interact with each other in detrimental ways.

Once the materials are specified and the system is designed, its proper installation must be ensured through rigorous inspection during construction. A problem that manifests itself in the waterproof membrane is concealed by the outer cladding and is inaccessible for repair without removing that siding. Because many of the materials now being used to construct rainscreen systems have been developed recently, they do not have a long service history and may suffer unpredictable failures.

The current best practices for building envelopes include design review and periodic inspection by specialized envelope consultants. These consultants are either engineers or architects whose practice is focused upon the specific materials, methods, and workmanship necessary to construct a long lasting, weather tight building. Contractors have in house envelope quality control personnel whose work provides another layer of assurance that the materials and methods used to construct building envelopes are appropriate at each step of the process.

Like other envelope systems, exterior cladding using rainscreen systems will require ongoing inspections and maintenance. The level of maintenance required will depend upon the specific materials selected for use. Compromising quality throughout the process increases the probability of building damage.