Pressure Equalized Wall Systems - Synopsis

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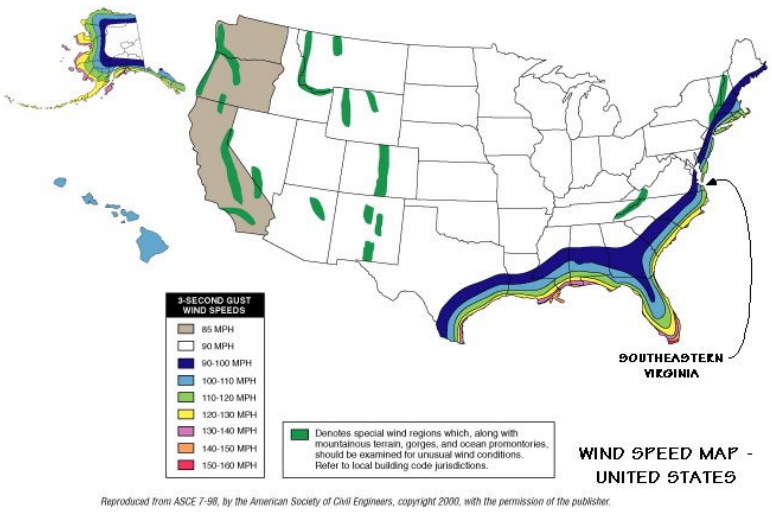
PRESSURE EQUALIZED RAIN SHIELD (PERS) EXTERIOR WALLS

Introduction

A successful method for deterring rainwater intrusion into exterior building walls is the rain shield approach. You have probably seen them before; even a rain fly over a camping tent is a simple example of rain shield. Rain shields shed most of the rain and manage the rest, preventing moisture intrusion and the resulting premature decay, deterioration and corrosion in multi-family residential and other buildings. More and more wall cladding material manufacturers are developing and marketing these kinds of rain shield walls because they are superior to the traditional face sealed “barrier wall” systems.

A more long-term weather resistant solution to the moisture intrusion experienced by high- rise and mid rise buildings is a pressure equalized rain shield wall system. Rather than attacking the symptoms of moisture intrusion, pressure equalized rain shields tackle the source - the forces that drive water into the building shell. They work by turning the wind forces back upon themselves. By neutralizing these forces, pressure equalized rain shields can withstand extreme environments. They appear to be effective in any climate and handle any weather condition short of a disaster.



WIND SPEED MAP - UNITED STATES

All pressure equalized rain shields include the following elements:

- Vented or ported exterior cladding
- Sealed Air cavity (of a calculated depth and size)
- Drainage layer on the interior face of the drainage cavity
- Rigid, water-resistant, airtight, support wall

Here Are the Details

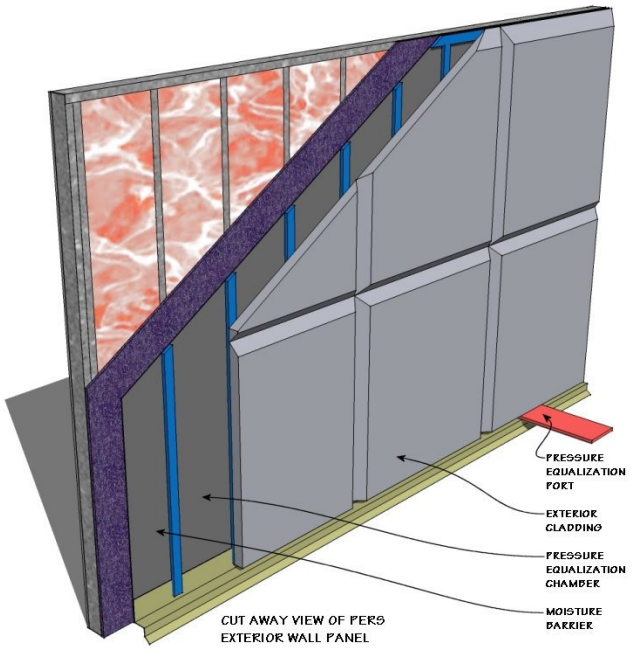
There are four basic approaches to water penetration control in building exteriors:

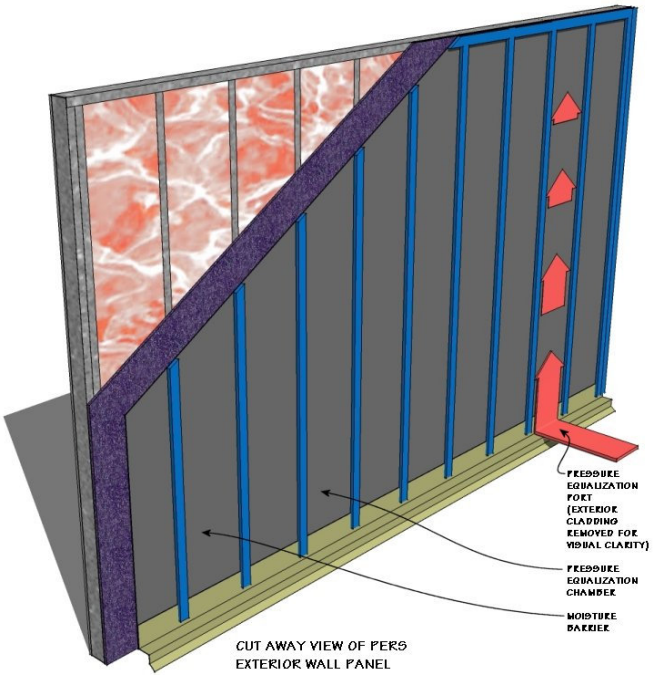
1. Mass: traditional, solid assemblies that shed most surface water, effectively absorb the remainder, and subsequently release absorbed moisture as a vapor. Examples include solid concrete, masonry, and timber structures. This approach has variable effectiveness in most temperate climates, but has low performance characteristics in extreme climates and weather conditions.
2. Barrier: surface sealed to completely shed surface water with no moisture penetration. Examples include barrier-type exterior insulation finish systems (EIFS) and stucco, vinyl siding, wood siding or glass curtainwalls built without a drainage plane (e.g., housewrap, building paper). These are effective in climates with less than 25 inches of precipitation annually.
3. Internal drainage plane: a drainage plane or moisture barrier located between the exterior cladding and the supporting wall that provides redundancy of moisture resistance. Examples include typical stucco, vinyl siding and cement clapboard walls built with a drainage plane. These are effective on low rise buildings shielded from winds in climates with an annual precipitation of less than 40 inches.
4. Rain shield: a moisture-management system incorporating cladding, air cavity, drainage plane, and airtight support wall to offer multiple moisture-shedding pathways. Rain shields diminish the forces attempting to drive moisture into the wall. There are two types of rain shields: simple rain shields and pressure-equalized rain shields (PERS).

   Simple rain shields: Examples include brick veneer cavity walls, furred-out clapboard walls, and drainable EIFS. Simple rain shields are effective in climates with an annual precipitation of less than 50 inches without intense or prolonged winds. Simple rain shields rely on the airspace next to the drainage plane to quickly and freely remove water from inside the wall. In a brick veneer wall, for example, rain water passing through the bricks and cracks can trickle down the back face of the veneer to either leak out of weep holes, evaporate, or be reabsorbed into the masonry.

   PERSs are effective in all climates, especially those with intense and prolonged winds or with an annual precipitation of 60 inches or more. PERS walls effectively "drain the rain," and they control powerful building wetting forces-gravity, capillary action, and wind pressure differences by returning the wind pressure against itself. Pressure-equalized rain shields (PERS), an advanced version of the simple rain shield, carefully integrate ported exterior claddings, compartmentalized air spaces, specific ventilation, and watertight, airtight support walls. PERSs terminate the pressure differential across face cladding systems that are magnified by winds. This effectively eliminates the remaining moisture force affecting rain shields. PERS systems employ barriers to compartmentalize the air cavity, thereby allowing rapid air pressure equalization and minimal moisture intrusion. This limits the opportunity for rain penetration beyond the cladding.

Developed in Canada in the 1960's, PERS was a response to the destructive forces of freezing water inside exterior wall construction. Canada Mortgage and Housing Corporation (CMHC) documentation provides technical guidelines for the design and construction of PERS walls. It has since proven very effective for the long term control of moisture leaks in mid and high-rise buildings subjected to intense wind forces such as those of the Atlantic Coast of the United States.





Design and Installation

PERS systems go beyond the simple rain shield design. At a minimum, compartmented seals should be at building corners and parapets, the more structural and airtight the compartment seal and air barrier assembly, the better. Ensure the support wall materials offer sufficient rigidity against depressurizing flexure during wind loading. Pre-fabrication of the PERS walls into panelized assemblies is very advantageous because of the higher quality control necessary to construct the sealed air chambers is readily achievable in the factory. Wall panelization also offers the advantages of faster enclosure of the building or less facility downtime in the case of a recladding project.

Benefits/Costs

The rain shield design technique offers significant advantages over other systems:

It neutralizes physical forces inducing water intrusion.

It is a simple, forgiving system with built-in, multilayered redundancy, and

It has integrated drainage and ventilation that accelerates cavity moisture removal.

Rain shields prevent or reduce moisture problems in exterior walls, including corrosion and peeling paint. Thermal shock, solar driven moisture effects, and pressure forces are diminished. In high moisture environments, the additional cost and complexity of PERS construction are cost effective over the long term.

Rain shield designs do not increase the cost of EIFS and other veneer wall systems. To install the air space behind the cladding in most assemblies, however, costs for furring or other spacer materials cause costs to increase. The few cents per square foot spent on a rain shield offer exceptional value to design professionals seeking liability protection, builders wanting to avoid callbacks, and homeowners looking for comfort.

Limitations

Moisture within a simple rain shield can be drawn into the inner wall if the forces acting on it remain high due to storm or climate. Small weep holes similar to brick veneer walls may be incapable of balancing pressures quickly enough, and vermin and insects may nest in the cavity.

Applying PERS technology to a wall or joint demands additional detailing and design by experienced professionals to make sure the cavity pressurizes quickly to keep the interior and exterior pressure differential at (0) zero. Short-lived sealants and foam gaskets that disintegrate will decrease the effectiveness and may incur future maintenance costs and should not be used. Mechanical seals (e.g., metal flashing, gasketed furring strips) offer a more permanent approach, but increase cost and complication.

PERS air barriers of comparatively flexible rigid foam sheathing like all thin film coatings are inadequate unless supported by and secured to a rigid substrate (e.g., ½-inch thick cement board) capable of withstanding dynamic wind pressure loading.

Code/Regulatory Status

Current building codes do not mandate rain shield designs. They are, however, increasingly under consideration for adoption into building codes. Code criteria are typically based on structural issues, not moisture control issues. Advocacy and manufacturer recommended practices have developed through trial and error.

Availability

Simple rain shield walls are built regularly from readily available materials. In fact the PERS principles work regardless of the exterior finish of the walls. PERS walls are not common in low-rise residential construction but they have been done with great effect along exposed coastal areas. Compartment seals for PERS systems are neither well understood by builders nor in widespread use in the developer based residential market. Commercial PERS systems are becoming more popular, which may lead to faster, more cost-efficient, mid and high-rise multi-family residential building integration.

Right here in Hampton Roads we have several fine examples of how these walls perform year after year for coastal associations.

The Colony Condominium is a 39-dwelling-unit, 11-story high-rise timeshare condominium located on the oceanfront in Virginia Beach, Virginia. In late 2002 an investigation of the east-side exterior wall was conducted due to reports of ongoing incidences of moisture intrusion at many of the east facing dwelling units. The Colony, similar to many other buildings in its time, was clad in EIFS, (Exterior Insulation and Finish System). The existing metal studs in the east wall were found to be so corroded that they were no longer safe. Based on the results of investigation, the Association took immediate action and requested plans and specifications to be drawn up for the re-cladding of the exterior walls of the building. To accommodate these special circumstances our Forensic Design Team designed a prefabricated wall system that utilizes the Pressure Equalized Rainshield System, (PERSS), concept that was the first such retrofit of an existing building in Virginia Beach. The PERSS concept turns the pressure caused by blowing wind against itself to stop wall leaks. In fact, the harder the wind blows against the side of the building, the more leak-proof the walls become. In addition, they gained a significant increase in R-value to add to the thermal comfort of the occupants and lower energy costs.

Since The Colony is a timeshare condominium, minimizing construction down time was of the essence to the Association. Because of the innovative design of the panel overlay, the amount of construction down time for any one unit was only one week! The redesign of this building won recognition from the City of Virginia Beach which gave the association and the architect a design award for the striking transformation. Today, The Colony Condominium has a striking new appearance that, in the words of one unit owner, “has given them increased resale values for the first time in a dozen years!”