PRESSURE EQUALIZED RAIN SHIELD (PERS) EXTERIOR WALLS

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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 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 in multi-family and other buildings.

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.

All rain shields include the following elements:

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

Details

There are four basic approaches to water penetration control in buildings:

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 characteristic in extreme climates and weather conditions.
2. Barrier: surface designed to completely shed surface water with no moisture penetration. Examples include barrier-type exterior insulation finish systems (EIFS) and stucco 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 and 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 PERS design and construction. It has since proven very effective for the long term control of moisture leaks in high-rise building subjected to intense wind forces.

Installation

PERS systems go beyond the simple rain shield design. At a minimum, compartment seals should be installed 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 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 typical of 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. 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 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

Current building codes do not mandate rain shield designs. They are, however, increasingly under consideration for adoption into building codes. Code criteria is 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 daily from readily available materials. PERS walls are not common in low-rise residential construction. 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, high-rise building and multi-family residential integration.