TECHNICAL SERVICES DIGEST July 2014

SUBJECT: Rain Screen Masonry Veneers and Drainage Walls

Rain screen claddings have gained popularity in recent years. The concept is to provide drainage and air circulation behind the cladding to isolate it from the exterior supporting wall and help prevent moisture migration. They work well for many wall systems, but there may be some unintended consequences that architects should consider.

The pressure equalized masonry rain screen system is a popular concept that consists of several components that must all work properly to keep the supporting wall dry (Fig. 1):

1. An anchored or adhered masonry veneer system.
2. A drainage cavity behind the veneer.
3. An air and water resistant barrier (WRB) behind the drainage cavity
4. Flashing and weep holes at the bottom of each panel of veneer.
5. Air vents at or near the top of the veneer panel to allow air to circulate behind the panel.
6. Air dams that create compartments in the drainage cavity that are intended to balance wind pressure and prevent driving rain from entering the vent holes at the top of the veneer panel.

This system differs from the traditional drainage wall in that it adds air vents at the top of the panel and air dams to compartmentalize the drainage cavity.

Theory:

The theory is that in traditional drainage walls, water vapor builds up behind the veneer and is driven by solar heating of the veneer and air pressure differentials to enter the building through vapor permeance or gaps in the WRB. Rain screen walls are intended to provide air circulation behind the veneer to relieve that vapor pressure. The problem with the theory is that any hole in the veneer will adequately relieve any vapor pressure behind that veneer, and circulating air is not necessary to accomplish that. Water vapor is a gas, and if gas pressure increases in a confined area, it will escape through any holes in that confinement.

While that may be true in some very wet climates, the drainage wall without rain screen vents has worked very well on many buildings for more than 100 years. That is because most drainage walls have several ways for moisture behind the wall to escape:

1. Weep holes. An open head joint in every third brick at the bottom of a modular brick panel has an area of approximately 1.1 square inches. Dr. Joseph Lstiburek demonstrated several years ago that such an opening will allow as much as 30 quarts of water to escape, when there is a significant difference in vapor pressure from one side of a panel to the other.[i] His statement referred to a 4x8 sheet of gypsum board, but an opening is an opening.
2. Vapor diffusion. In the same article, Lstiburek stated that approximately 1/3 quart of water would diffuse through a sheet of gypsum wallboard in the same 24 hour period. Depending on the body type and surface finish, brick and mortar will be more or less vapor permeable than drywall, but there will be some diffusion. The main exception would be glazed brick or structural glazed tile, which have little or no vapor permeance. But water vapor would still escape freely through open weep holes.

Open weep holes provide many times more water vapor to escape from behind the veneer than can diffuse through the veneer. Adding vents at the top of the wall will increase this even further, but those same vents can easily allow wind-driven rain to enter the cavity and run down the WRB. This added water makes the cavity moisture worse, not better. The WRB is now the only barrier to water entry into the building. This eliminates the redundant levels of water resistance provided by the traditional masonry drainage wall.

Practice:

Compartmentation with air dams theoretically prevents pressure differences between the outside of the veneer and the cavity. Unfortunately that theory has some holes in it (literally):

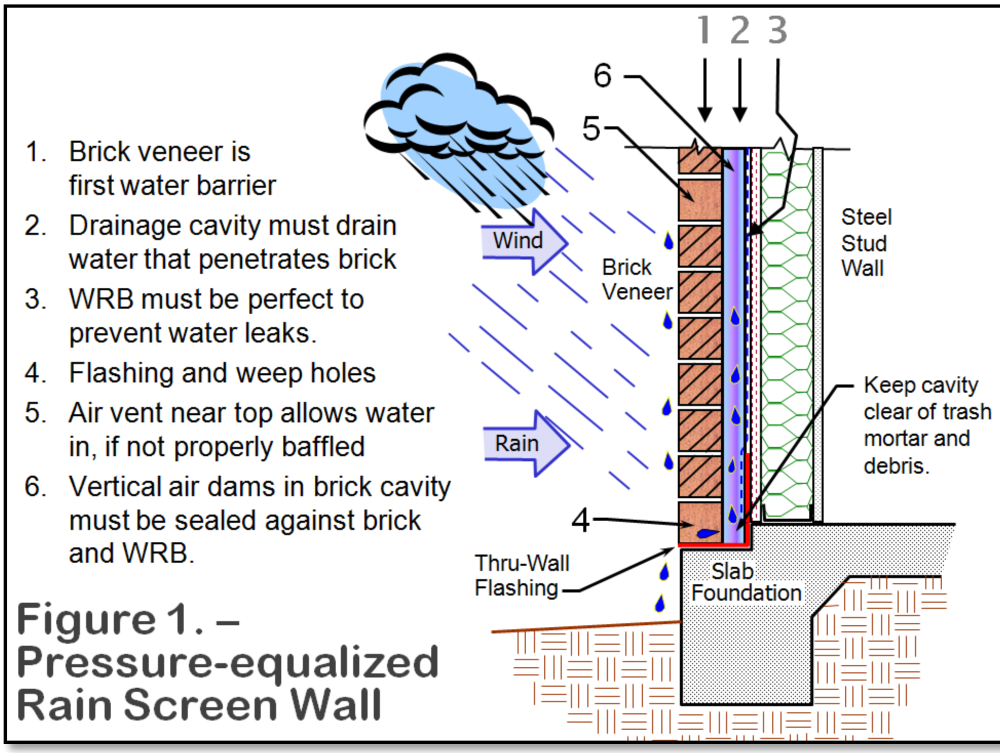

Figure 1. – Pressure-equalized Rain Screen Wall

1. Wind driven rain not only produces pressure on the outside of the wall, which must be balanced to prevent air flow into the cavity, but rain drops have a high velocity as they impact the wall. If one of these drops hits a vent, which it most certainly will, it will drive deep into the vent and enter the cavity.
2. The WRB will likely have some holes in it. No construction material is perfect and installation methods are never perfect. The best we can hope for is to provide a nearly continuous air barrier around the building envelope. But where that fails, warm, moist air can get in or out. And many buildings have negative pressure inside that can draw in water vapor, or even liquid water. Adding vents at the top can allow liquid water to enter theses holes, not just water vapor.
3. Compartmentation of the brick cavity requires a level of precision in creating air dams that many bricklayers do not have, and air dams cannot be inspected, because they are covered with brick. Each air dam must be continuous and must be sealed against the WRB at the back and the back of the veneer at the front.
4. If rain screens are to be practical, vents must be so arranged as to prevent wind-driven rain from getting into the cavity on impact. A 90 mph wind can push water upward over a six-inch barrier. A water baffle insert that rises inside the brick cavity at least six inches to prevent water entry is a necessary part of a good rain screen design.
5. Any negative pressure in the building will draw this extra moisture into the light-framed wall system to cause mold or corrosion.

Traditional drainage walls:

Rain screen wall systems are an alternative to drainage walls that could work if everything were built perfectly, including water baffles on each vent. But real walls are not perfect. Traditional drainage walls are much more forgiving (Fig. 2).

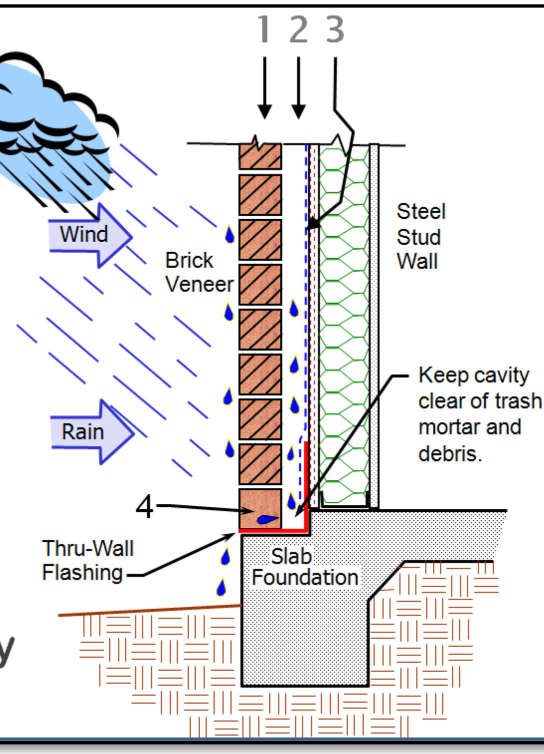

Figure 2. – Traditional Masonry Veneer Drainage

The most common failure is weep holes blocked with trash mortar. This is easy to prevent. If the bricklayer leaves out every third brick at the base of the panel, they form cleanouts that allow the bottom of the cavity to be inspected, and trash mortar removed. When the rest of the panel is complete, the bricklayer inserts a new brick in the cleanout, leaving an open weep hole that will function reliably.

Flashing must be continuous at the bottom of each panel. It must also begin at least 8" up from the brick ledge or support and through the veneer to the outside edge. Flexible flashings can be trimmed flush with the wall face or sealed against a stainless steel drip edge. Either way, terminate the flashing system at the face of wall. There is no need to project the drip edge out past the wall face and turn it downward. Such drip edges make flashing and sealant installation much more difficult and create a shiny surface that may not be aesthetically pleasing.

Most of the moisture damage we have seen in light-framed walls appears to come from air leaking through the joints in exterior sheathing into the stud cavities. This can happen equally with drainage walls or rain screen walls. The best preventative for this leakage is a continuous air barrier throughout the building envelope.

Overall, drainage walls function very reliably when installed with proper flashing and weep systems. They are much less expensive than pressure-equalized rain screen walls and provide far greater redundancy against water and water vapor intrusion into the building envelope. Figures 1 and 2 show the basic construction of each wall system.

[i] "Insulations, Sheathings and Vapor Retarders Research Report – 0412," November-2004, Joseph Lstiburek