altus group

Technical Brief

Rain Barriers and Rain Screens

Above: The Heights Residence Hall, Montclair, N.J.
Architect/Engineer: PS&S Architecture PC
Precaster: High Concrete Group LLC

carboncast

C-GRID® REINFORCED
C-GRID is a trademark of Chomarat, NA

In buildings, water has the unfortunate habit of getting where building owners don't want it to go. And once inside a building it has the potential to do significant damage.

Buildings gain, lose, and store moisture along with heat energy through a variety of physical mechanisms. Operating durability, efficiency and serviceability of the structure can be affected by moisture flow. Controlling moisture flow in a building also has significant impacts on occupant health, safety and comfort.

continued

Introduction *continued*

Modes of moisture flow into buildings include:

- **Precipitation** – rain and moisture making their way through openings in building surfaces.
- **Water vapor evaporation** – liquid water changing into a gaseous or vapor state and is absorbed into the air.
- **Diffusion** – water vapor moving under pressure from areas of high concentration to areas of low concentration and also high temperatures to low temperatures.
- **Condensation** – water changing from a vapor state to a liquid state as air becomes saturated. Where condensation occurs matters.

Architects generally have two approaches:

(1) keep moisture from penetrating the wall assembly or
(2) assume it will penetrate the assembly and provide a way to remove it.

Above: Dollar General Distribution Center, Bessemer, Ala.
Architect: Leo A. Daily Company

Right: Henry W. Bloch Executive Hall for Entrepreneurship and Innovation, Kansas City, Mo.
Architect: BMIN

Rain Barriers vs. Rain Screens

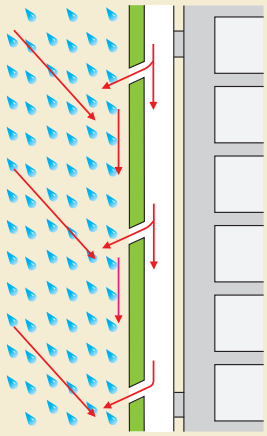
Rain barriers are often face-sealed curtain walls and have sealed joints between the components. Drainage is generally not required in these assemblies for moisture originating from the exterior. For the wall to remain effective, the joints must be maintained because they typically represent the weakest parts in the system. The most effective rain barriers will have the fewest joints and be made of the most durable building materials.

Precast cladding, including all CarbonCast Enclosure Systems, can be considered a face-sealed curtain wall. The concrete, typically over 5,000 psi in strength, absorbs and passes very little liquid water. Panel joints should have either two layers of sealant or sealant and a secondary method of defense against water penetration. Joints around openings should have primary and secondary seals.

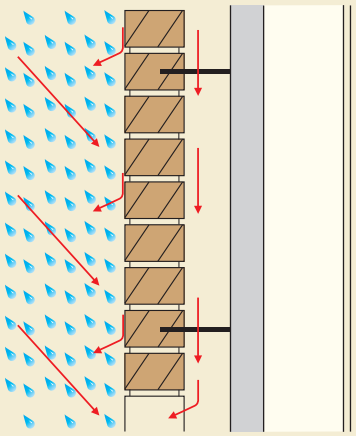
Rain screens begin with the premise that water will eventually penetrate the exterior wall system and that a mechanism must be designed to drain it. They are not water-tight and are typically ventilated. The screen relieves most of the driving pressure of water, then drains or evaporates it through a cavity behind the façade. Rain screens generally entail more complicated design and construction practices and material selection to ensure proper water flow and minimize the potential for damage once the water passes the screen. They also have more variability in materials and often more joints and opportunities for water penetration.

Moisture (both liquid and vapor) will accumulate if the rate at which it collects in the space exceeds the rate of removal. Repeated wetting, followed by repeated drying, may be acceptable as long as materials do not stay wet long enough to freeze or deteriorate.

The most effective rain barriers will have the fewest joints and be made of the most durable building materials.



Rain screen: panel cladding system



Rain screen: masonry veneer

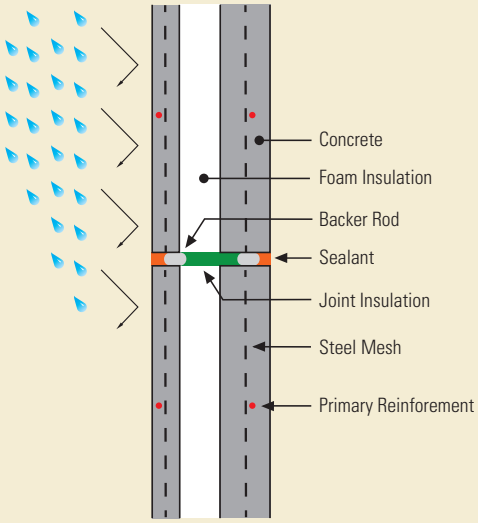
Above: Rain screens permit moisture to penetrate the exterior wall system. They must be designed to drain the water back to the exterior, which often requires complicated engineering and construction practices.

Left: Traveler's Rest High School, SC
Precaster: Metromont
Architect: Craig Gaulden Davis/Perkins + Will

A Versatile Rain Barrier

CarbonCast High Performance Insulated Wall Panels, like most precast wall panels, are strong enough to withstand high winds and wind-driven projectiles, hurricanes, and wildfires when properly installed to code and maintained. They are also impermeable to air infiltration and wind-driven rain. The high tensile strength of reinforced concrete combined with proper compaction imbues the material with the capacity to withstand storms and render it resistant to wind-driven rain and moist outdoor air in hot and humid climates. In many cases, this strength is enhanced through prestressing, which further prevents the likelihood of cracking stresses due to shipping and handling.

Architects often ask if precast walls can be designed as a rain screen or drained system. They can. However, because they provide superior resistance to rain penetration and air leakage, they are often used as a rain barrier. In fact, using the drained approach with precast wall panels can introduce risk that water may damage the panel's structural connections. Why entertain that risk? Design for the sure solution!



Rain Barrier – Precast Wall

The high tensile strength of reinforced concrete combined with proper compaction imbues the material with the capacity to withstand storms and render it resistant to wind-driven rain and moist outdoor air in hot and humid climates.

Quality joints are essential. Fewer connections required.

As with any envelope system, joints between panels must be properly installed and maintained in order to provide a complete barrier system. Because precast concrete panels are often larger than other cladding systems, they provide an exterior envelope with fewer joints. Fewer joints mean fewer concerns. Joints of precast panels are typically sealed with backer rods and sealants installed by the precaster. Precast can also use non-welded bolted connections often with limited access and much tighter tolerances. (On the contrary, the hot weld slag sometimes used in rain barrier installation can penetrate the in-place membrane.)

For an added level of protection, precast wall panels joints can also be designed as a drained joint. It provides for a drainage space behind the backer rod closest to the exterior and a drainage opening in a vertical joint. The drainage opening must be configured in a way to prevent the entry of wind-driven rain. Similarly, flashing and joints around the window penetrations must be designed and properly installed to drain any water to the exterior face of the assembly.

While precast concrete walls are impermeable barriers, they should be designed to permit the movement of moisture on at least one side and should not be covered by an impermeable material on both wall surfaces.

Your precast design team will help you determine the ideal sealants, designs and processes to ensure the joints are a reliable component of the rain barrier system. They can also offer advice on material compatibility and elasticity to make sure other building products will function in concert with one another. They can also provide counsel regarding how to accommodate the performance and interaction of materials in various climates and exposure conditions.

Right: Photo courtesy of Sika Corporation

A Versatile Rain Barrier *continued*

One system, several barriers.

Energy code changes are compelling designers to approach envelope design differently. In most regions of the United States, building envelopes must provide continuous insulation and a continuous air barrier. Envelopes also are required to provide a vapor barrier to control condensation and indoor humidity, as well as avoid compromising the insulation system. Precast concrete mass walls also increase the benefits of thermal heat sink effects.

CarbonCast's edge-to-edge insulation with C-GRID carbon fiber grid wythe connectors provide a thermally broken, well-insulated wall design that prevents heat and moisture from penetrating the building. CarbonCast also eliminates thermal loss and vapor transmissions common in other wall assemblies. With the addition of continuous insulation to precast concrete walls, which already provide an excellent moisture barrier, CarbonCast Enclosure Systems effectively integrate the air, moisture and heat management of the envelope into an integrated, factory-fabricated system.

Summary

Why CarbonCast Enclosure Systems are an inherently better cladding choice for moisture control:

- Integral designed moisture and vapor barrier
- Fewer components to design and construct – less complicated field work, greater control during fabrication within the factory environment
- Larger panels mean fewer joints in the exterior wall systems, providing fewer opportunities for moisture penetration
- No drainage cavity space needed – make the most of your building footprint
- More cost effective; fewer possibilities for problems if not properly designed
- Eliminates mold / mildew problems

Testing confirms rain barrier.

The Rilem Tube test is a low-pressure test that applies water to a surface under a pressure approximately equivalent to an 89 mph wind. The test provides useful information about the water permeability of a surface.

AltusGroup has tested its CarbonCast Enclosures Systems with a minimal (1-3/8" thick) face. The test was conducted for a 14-day period. The location for the test was selected so that it would not be over or near cracks in the sample. The sample was allowed to dry at room conditions (i.e. 70 ±5°F and 50 to 60 percent humidity) for 7 days prior to the start of the Rilem tube tests.

After 14 days a total of 4.4 ml of water were absorbed over the area of the Rilem Tube (0.875 in^2). The foam insulation on the back of the panel was removed. There was no indication that the water from the Rilem Tube penetrated to the back face of the panel. The back of the panel was dry.

Wind-driven rain tests (pictured above) have also been successfully completed.

altusgroup®

AltusGroup
PO Box 1449
Bethlehem, PA 18018
866.GO-ALTUS (1.866.462.5887)

Visit **altusprecast.com** for more information on CarbonCast® Enclosure Systems and to find a precaster near your next project.

Call us today to speak with a technical representative or request a lunch-and-learn program.