TECHNICAL BULLETIN

Pressure Equalized or Drained and Back Ventilated Rainscreen Systems - AAMA 508 or 509?

Overview

Metal Composite Material (MCM) has been used as an exterior cladding material in North American construction for more than 40 years. While an extremely flat sheet material, MCM must first be fabricated into an assembly that can then be installed on a structure. These different assemblies are commonly known as installation "systems". This Technical Bulletin will focus on a particular classification of systems called "rainscreen" where system performance is determined by either AAMA 508-21: Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems, AAMA 509-21: Voluntary Test and Classification for Drained and Back Ventilated Rain Screen Wall Cladding Systems, or both. The goal of this paper is to provide a basic understanding of the intended performance characteristics that make each type of rainscreen system unique.

Discussion – What am I Specifying?

Even though the term "rainscreen" seems simple enough, there is a lot of confusion on this topic. The confusion begins with the fact that there are two different types of rainscreen systems: Drained and Back Ventilated Rainscreen Wall Cladding Systems (DBVR) and Pressure Equalized Rainscreen (PER). The intent of each specific test method to define performance and the level of performance desired will determine the type of rainscreen system used.

There are several fundamental understandings that the designer must be familiar with to specify the proper system.

- The intent of the AAMA 509-21 (DBVR) test method is to identify the amount of air and water penetration into the cavity behind the cladding material. The test method locates the performance levels on a chart that can then be compared to the performance of other rainscreen systems. **There is no pass/fail criteria. The test method provides a means of comparison.** The specification may identify a level of performance required, but there are currently no standard criteria to aid in that determination.
- DBVR puts a large emphasis on the Air/Water Barrier (AWB) which is designed as the primary weather protection and is generally the inside barrier of the drainage plane.
- The intent of the AAMA 508-21: (PER) **test method creates performance requirements with a pass/fail criteria**. Air and water penetration into the air cavity is measured against acceptable performance. In addition, the system response to pressure differences between the exterior environment and the air cavity are measured and required to meet certain levels.
- As proven over the years that this standard has been in place, PER is a bit of a misnomer. Due to the constantly changing pressures on both sides of the cladding, truly equal pressure is not a common occurrence. There will almost always be a pressure difference between the environment and the air cavity which in turn create a pressure on the exterior cladding due to wind load. The design community is beginning to gravitate away from "pressure equalize" and using the term "pressure moderated" to recognize that loading on the exterior cladding is a dynamic event.
- Regarding PER systems, ASCE 7-16 has recognized that there can be a division of load

across the various layers of a rainscreen assembly, however:

> "In the absence of detailed information on the division of loads, a simple conservative approach is to assign the entire differential pressure to each layer designed to carry load." (C30.1.5)

Also, the minimum design wind pressure for components and cladding of a building shall not be less than a net pressure of 16 lb/ft^2 (30.2.2)

What is the primary difference between the cladding installations?

The main difference between a cladding system complying with AAMA 508 and AAMA 509 is how they are vented and/or sealed – how much air and water the system is designed to handle (allow into the cavity and drain from the cavity). PER systems are designed to reduce the water that gets beyond the exterior cladding by reducing the driving factor (wind pressure difference). DBVR systems are not designed to impact pressure and allow more moisture to penetrate the façade, to the AWB.

Current MCM Installation Systems

Today's installation systems appear far more varied because each fabricator/installer has developed a unique installation method that addresses local environmental and performance concerns. Site conditions, shielding, topography, etc., may also play a big part in the choice of system type. Installation systems in Phoenix, AZ must consider panel cladding temperature where the ambient temperature is well above 110 °F. Installation systems in Seattle, WA are far less prone to excessive cladding temperature swings, however these systems must be designed to handle repeated, and often, excessive water. Other considerations include, among others, extreme cold weather; inter-story movement in seismic areas; and high humidity areas where mold could be an issue. In addition, technology and product development has brought on several new and very popular systems that reduce both the time required and overall cost of installation.

Drained and Back Ventilated Rainscreen System (AAMA 509):

AAMA 509 STANDARD INCORPORATES THE FOLLOWING TEST STANDARDS:

- ASTM E 283 – Air Penetration
- ASTM E 330 – Structural Performance
- ASTM E 331 – Water Penetration
- AAMA 501 – Dynamic Water Penetration

DBVR systems allow water to enter the air cavity behind the cladding through the system joinery. The minimal amount of water that does enter the air cavity, is drained to the exterior while the air cavity dries through ventilation. A solid backing such as gypsum board must be correctly installed to support the AWB and to withstand any pressure experienced through the air cavity. A properly designed DBVR systems will control the amount of water passing through the exterior cladding joinery, while the AWB, generally located on the air cavity side of the sheathing provides a "final" layer to inhibit water infiltration into the building. All components must be properly designed and installed to control any water that enters the air cavity and contacts the AWB.

DBVR systems have been developed using many different connection details. The most common MCM systems are the Open Joint (Figure 1) and the Spline System (Figure 2).

The spline system is really a description of one method used to construct and finish the joinery in any type of rainscreen system. The spline element, used to close off the panel joinery and provide a significant deterrent to water infiltration, is a solid material such as a strip of metal or MCM inserted into a reveal in the panel perimeter extrusions. The

Tested to AAMA 509 standards

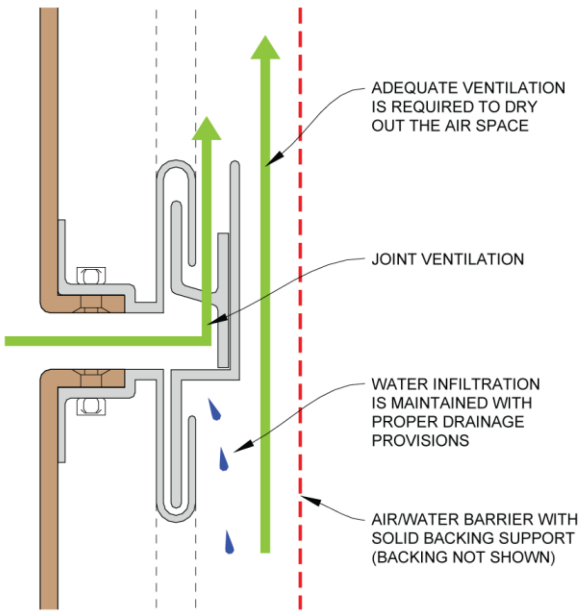

Figure 1 - Drained and Back Ventilated Rainscreen System Horizontal Joint (Example)

Tested to AAMA 508 or 509 standards

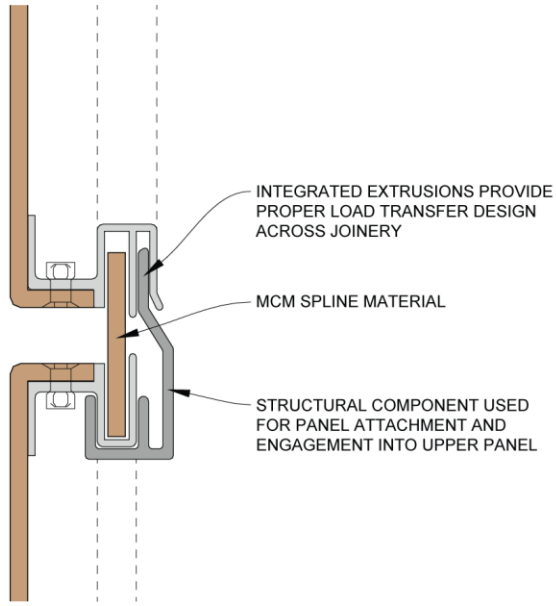

Figure 2- Spline System Horizontal Joint (Example)

spline element may not be designed to transfer loads across the panel joint as there is generally no rigid connection between the spline and the perimeter extrusions. The spline not only provides control of water infiltration, but also has a role in air cavity venting. The spline also serves to conceal any exposed fasteners used in the attachment of the panels.

Pressure Equalized Rainscreen System (AAMA 508):

AAMA 508 STANDARD INCORPORATES THE FOLLOWING TESTS:

- ASTM E 283 – Air penetration
- ASTM E 330 - Structural Performance
- ASTM E 331 - Water Penetration
- ASTM E 1233 - Pressure Equalization Behavior - 100 three second air gust cycles in which the wall needs to equalize pressure in less than 0.08 seconds
- AAMA 501.1 - Dynamic Water Penetration

PER systems are also evaluated based on air and water penetration into the air cavity, however there is much less demand on the AWB as the primary weather protection. AWB is still an important element, however less than 5% (area) of the water mist or droplets can appear on the AWB surface. Pressure within the air cavity helps to limit water infiltration. This allowance for air cavity pressure change must take place in a very limited time, not to exceed 0.08 seconds, which takes away the driving force transporting water into the air cavity.

PER are designed on the concept of having close to equal pressure on the exterior of the cladding and the air cavity. With limited pressure difference between the exterior environment and the air cavity, there is no force present to drive rain behind the cladding and into the air cavity. The PER concept has been proven in many applications and is widely used throughout the industry.

While the process has come to be known as pressure "equalization", it is generally recognized through testing that the effect is more a moderation within the air cavity to reduce the difference in pressures. To achieve true "equalization" in real world application involves not only the cladding installation system, but compartmentalization and location of venting that is difficult to achieve in actual application

Pressure equalization is achieved by venting the air cavity in precisely the correct locations and vent sizing. This venting allows air to quickly pass through the cladding joinery allowing the air cavity to quickly reduce the pressure differences with the exterior environment while controlling water infiltration. Keep in mind that wind pressure, both positive and negative, are constantly changing for the cladding on a structure and those loads are constantly changing at different elevations and around the structure.

The air cavity is typically divided into sealed and separate compartments to also help equalize the cavity evenly. It is very common to see the edges of a compartment change more rapidly than the center section and if the compartment is too large, the panel edges and center are not in sync with each other creating panel deflection due to differential pressure. Compartmentalization also prevents the pressure within the air cavity from migrating between higher and lower pressure zones. One method to limit movement of air in differing pressure zones is the use of vertical and/or horizontal seals (Figure 3), however compartmental design is beyond the scope of AAMA 508. When properly designed and installed, specified levels of pressure equalization can be proven by laboratory test results to nationally recognized standards.

Tested to AAMA 508 standards

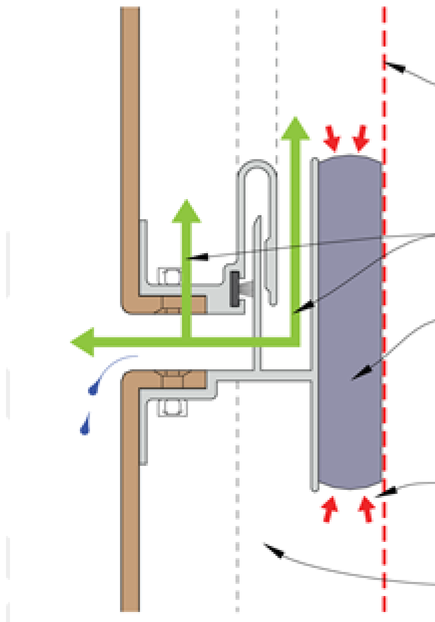

Figure 3 – Pressure Equalized Rainscreen System Horizontal Joint (Example)

Summary

While this paper addresses only the most significant points of rainscreen design and testing. Individuals, companies, and laboratories make an entire career out of the intricacies of this science and there is still a great deal to be understood based on real world experience. One thing that is sure is that there are different types of rainscreen systems that lead to different design considerations. Each type of rainscreen (DBVR and PER) has an AAMA test standard that helps identify and determine acceptability.

	DBVR	PER
Test		
ASTM E283	X	X
ASTM E330	X	X
ASTM E331	X	X
ASTM E1233		X
AAMA 501.1	X	X

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Critical elements include the cladding itself; the AWB; and the exterior sheathing. Each serves a critical role in the performance of the system.

The exterior cladding of a rainscreen system is not designed to be watertight like past "sealed systems". If the intent is to stop all water penetration at the façade cladding surface, rainscreen systems are not the right answer.

Having an awareness of these two types of rainscreen systems, and what the differences mean, before specifying a project will surely save time and costly change orders or repairs once construction starts.

Which system is better for the North American market? That is a complicated question that many design professionals have conflicting answers for, but what is clear is that the likelihood of a successful exterior cladding system hinges on understanding the rainscreen principle and how both air and water are measured.

Additional specification information can be found on the MCM Master Specification at www.metalconstruction.org

References:

Anderson, J.M. and Gill, J.R. 1988 Rainscreen Cladding a guide to design principles and practice.

American Society of Civil Engineers. 2016 Minimum Design Loads for Buildings and Other Structures - ASCE7-16

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