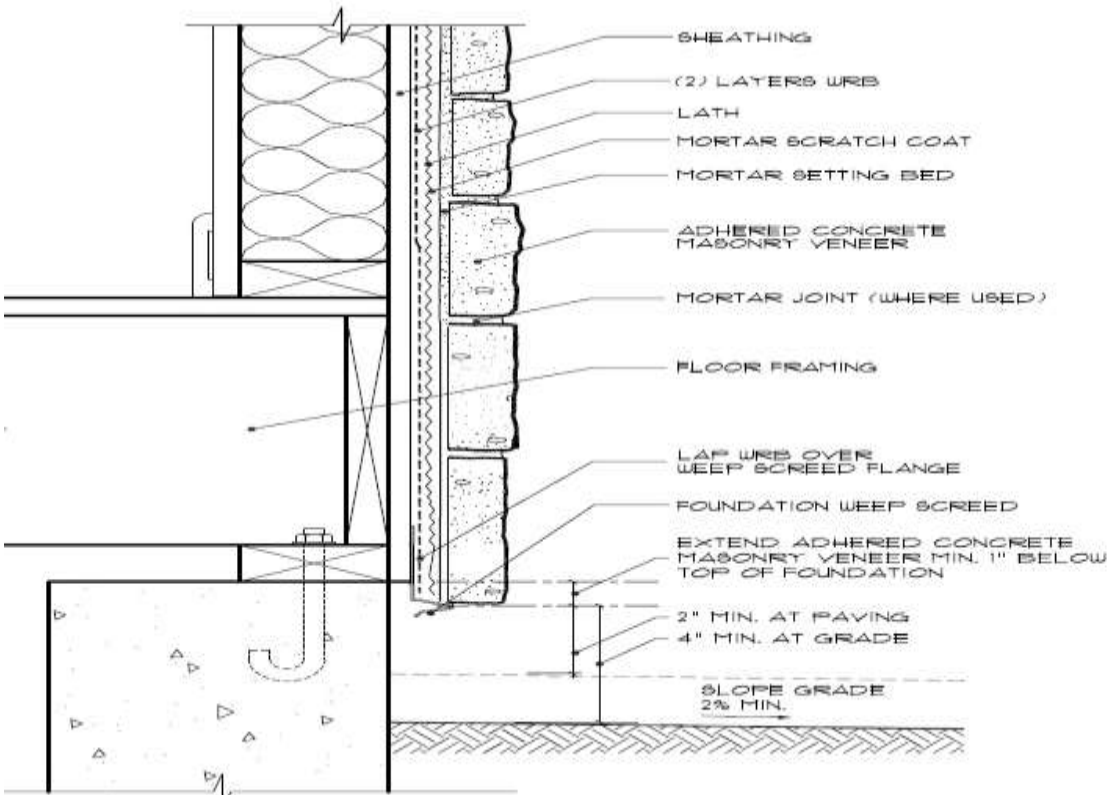
A.C.M.V. stands for Adhered Concrete Masonry Veneer. This material is a man made "stone" that is applied to the exterior walls using a wire mesh and cement-based adhesive. This "faux stone" has become a very popular exterior façade on many homes in the southwestern part of Ohio in recent years. While the material and related components are safe to apply to residential and commercial building exterior facades, **there are critical installation requirements** that must be followed to insure that no moisture can access behind the ACMV material and/or the drainage system that is incorporated into the ACMV system. There have been many ACMV systems that Finegan Inspection Services, Inc. has inspected over the past 26 years. While many of these ACMV systems are functioning properly, there are also many that have been installed incorrectly and/or have caused moisture damage to exterior wall assemblies.

The installation of **drains at the bottom** of the ACMV, **flashings at wall** and various intersections with other wall and roof components, and the creation of **expansion room** for all wall components that are in contact with the ACMV are just a few of the most frequent installation requirement mistakes or omissions seen by this company over the years of inspecting these systems. Installation errors often occur when the persons who are installing the material do not read the directions that are provided by the various manufacturers of these systems.

A typical wall section looks like this:



Basic glossary of most commonly used terms

ACMV - The entire **Adhered Concrete Masonry Veneer** "system" of a man-made stone material made from concrete. The attachment systems are a wire mesh that is secured through felt paper against the substrate. There is a base coating of a cement based concrete over the mesh. Once the base coating has dried, the stone is adhered to the base coating using a modified cement material. Things like caulking and flashing systems associated with the application of these systems are defined in the installation instructions by the manufacturer. Most manufacturers draw a line at these related components as to their responsibility for the correct or incorrect installation of those components.

ATTACHMENT SYSTEM- The materials used to secure the stone to the substrate. These could be mechanical fasteners such as staples that are designed for this material. Stainless steel is the most common type of staple used. Staples resist gravity, wind suction, and the shearing effects of thermal movement so as to keep the mesh secure to the walls.

BACKER ROD- Around virtually all windows, doors, and other wall penetrations, there must be a gap of approximately ½" in which a flexible closed-

cell type of foam plastic rod is inserted into the joint cavity at a specific distance from the outside face of the joint. This is accomplished prior to application of the caulking so as to provide proper expansion and contraction and limit the depth of the sealant application.

BASE COAT- This is a cementitious coating that is applied to the expanded wire mesh surfaces. The wire mesh is secured to the substrate on the walls prior to base coat application. The base coat adhesive is mixed with Portland cement that is modified with specific polymers and is applied in a thin, continuous layer to the mesh. When the base coat is cured, (24 hours is normal time), the ACMV stone has a thin layer of cement applied to the back side of the stones and these are then pressed into place on the base coat surfaces.

BASE FLASHING- At the bottoms of some window systems and doors as well as at deck and awning installations, there are flashing systems that are recommended by some manufacturers of some ACMVsystems. These may also be referred to as APRON FLASHINGS.

DIFFERENTIAL EXPANSION- All exterior walls have some type of covering, (called the building envelope), to keep water and weather away from the interior of the wall structure. Often times the exterior components vary and are made of different materials. These different materials have physical properties that allow them to expand and contract with the heat and cold temperatures at different rates. Where two different materials intersect, (i.e., brick and ACMV), the expansion and contraction differential of the building components must be taken into account when installation of the ACMV is considered. There must be some type of allowance built into the installation of the various materials at their interesections in order to compensate for the different expansion rates, while simultaneously keeping water and weather out of the wall assemblies.

DIVERTER FLASHING- At locations where lower roofs intersect the vertical plane of a wall surface at the eave line, there must be a specific type of flashing installed at the intersection location of the eave and the wall. This flashing looks like a bent “L” on its side. It is installed prior to the ACMV installation. The diverter, (also known as a kick out” flashing), design is to push roof water away from the wall surface and into the gutter. Because this area is a significant water entry point behind many wall envelope surfaces such as ACMV and EIFS systems, the diverter must be installed properly so that it can successfully direct water away from the wall surfaces and into the gutters.

While the pictured diverter is installed in an EIFS system, the same diverter would be installed with ACMV stone

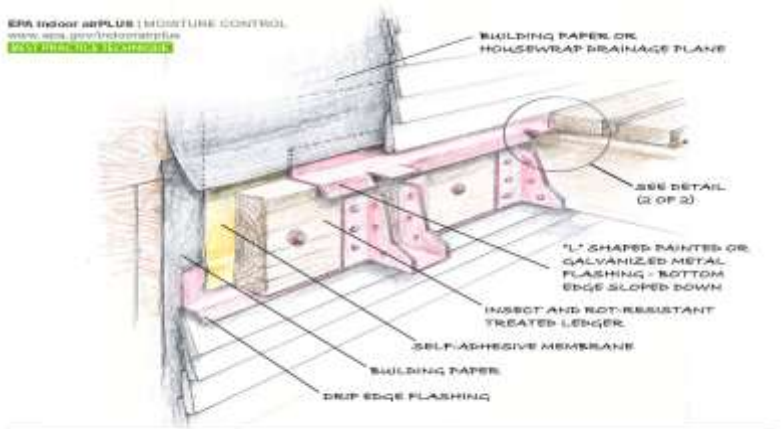
DRAINAGE SYSTEM- There is intended to be a drainage gap between the back of the ACMV and the face of the substrate. These systems were designed to allow water to "drain" behind the ACMV system and not be trapped against the substrate. If the felt paper is not backed up with a house warp of if there are gaps in the felt paper, water access can occur.

END DAM FLASHING- Where there is an opening in the ACMV material to allow a horizontal flashing installation, there should be a vertical termination at the ends of the horizontal flashings. This is done to contain any horizontal water flow behind the ACMV at these terminations that may be caused by wind-driven rain. An end dam is mostly discussed when referring to a roof system or deck ledger flashing system.

EXPANSION JOINT- Because of expansion and contraction cycles as well as thermal and wind shear characteristics on all building envelope systems, there must be specific expansion and contraction relief joints. The location, size and profile of the various joints are critical to the overall performance of the ACMV system. The lack of an expansion joint at the intersections of the ACMV with other materials will make the system vulnerable to leakage.

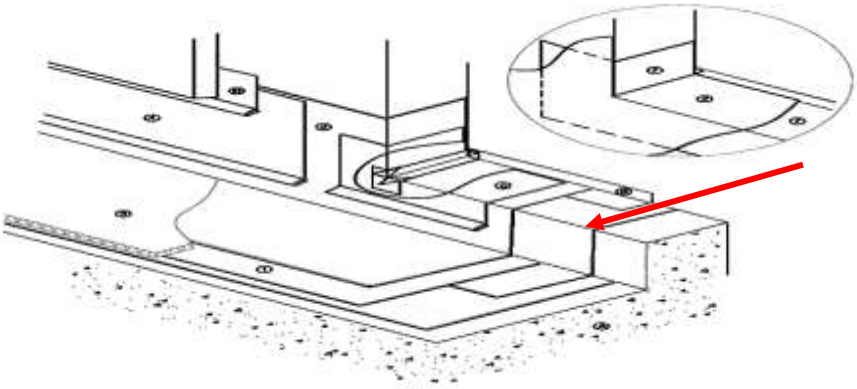
HEAD FLASHING- Above windows and doors there are "head" flashings as often required in modern ACMV systems. It is not required in all applications, but recommended. At the ends of any head flashings, an end dam is usually a modern requirement

LEDGER FLASHING- At most locations where a deck is attached to an exterior wall that has an ACMV system, there always should be an L-shaped flashing installed at the location where the ledger board attaches to the house wall. The ledger flashing must be installed prior to the ACMV installation. It is installed above the ledger board and is intended to capture any water that may get behind the ACMV and to drain it safely way from the wall. This ledger flashing often needs an END DAM at the horizontal termination points.



FLASHING DIVERTING WATER FROM DECK LEDGER (1 OF 2)

PAN FLASHING- Under all doors a drain pan system should be installed between the top of the sub floor and the bottom of the door threshold. This is generally known as a pan flashing. It can take multiple forms---from a membrane that is formed into a proper shape to a metal-soldered profile. The exterior door is set into the rough opening of the wall and is set into this "pan". This pan that has upturned sides and the interior side is also turned upward so that the pan can capture any moisture that may drain around or below the door and direct that moisture out of the door threshold area to the exterior.

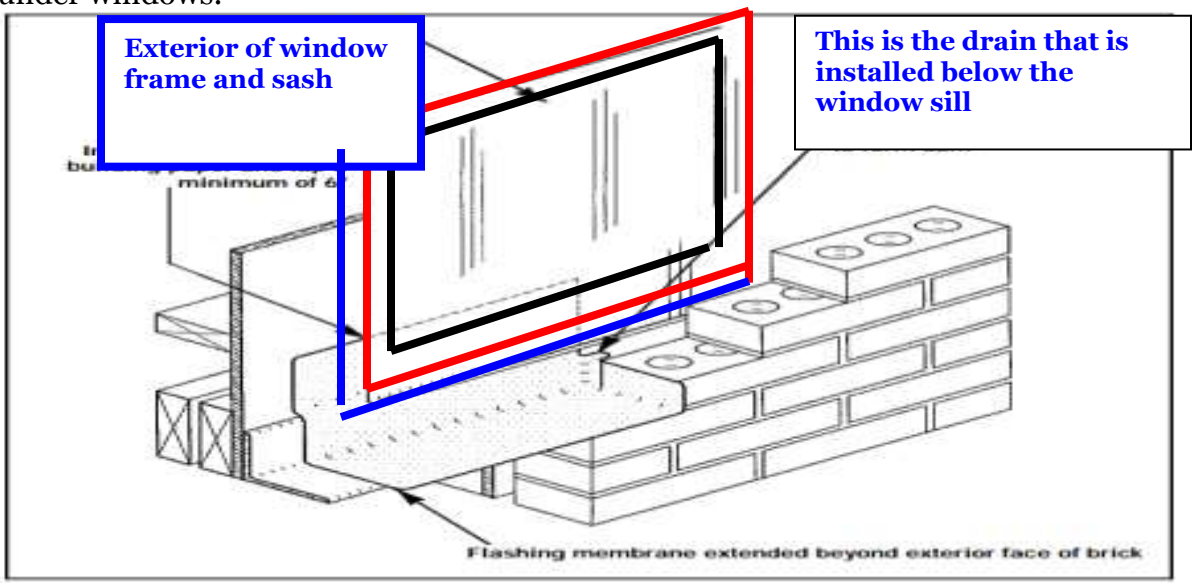


This is the floor of the rough opening for a door. The flashing details that are set in place prior to the installation of the door

SUBSTRATE- This is the exterior building surface to which the ACMV is applied. It could be oriented strand boards, plywood, cement board, or other approved materials. The substrate is the surface to which the steel mesh is secured to the wall structure.

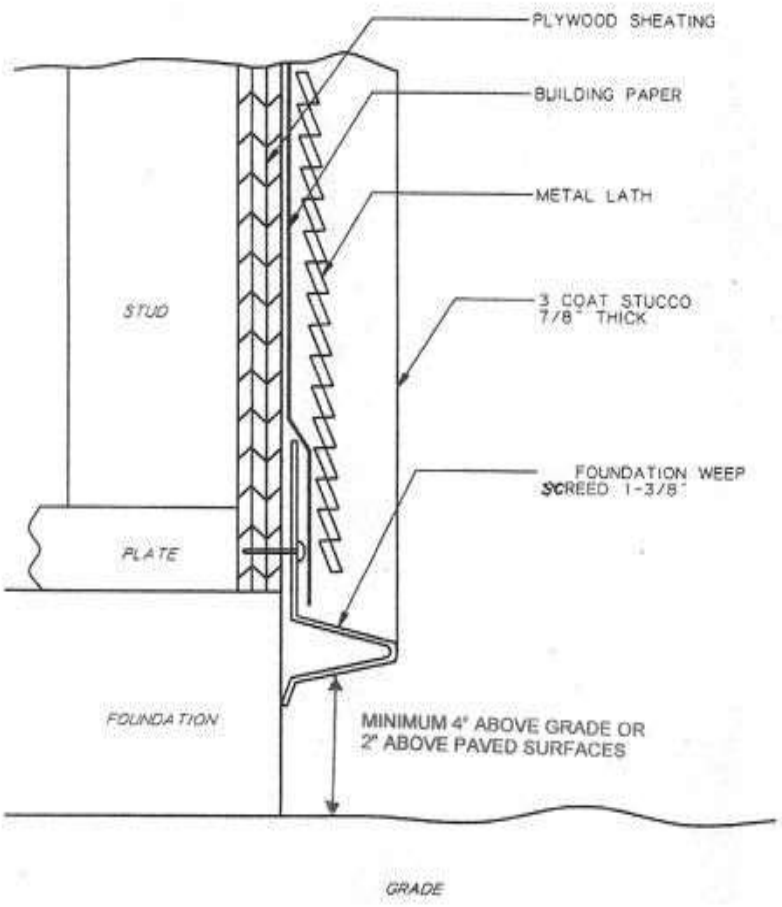
SEALANT- The caulking applied to the various gaps in the systems caused by wall penetrations such as, but not limited to, windows, doors, vents, and expansion joints. Most are wet applied and must be carefully installed. These are one of the areas of highest system failures. The products are often silicone-based with one or two parts urethane and some with polysulfide. Many sealants require a bonding primer applied to the joint cavity prior the application of the sealant.

SILL DRAIN- In recent years, the development of components to aid in the restoration of the ACMV has been developed by various companies. It has been proven that most windows and doors leak water at the bottoms of the units. This is called the sill. Because many systems do not have a drainage system behind the surfaces, the water that leaks from the windows or doors, often times becomes trapped between the back of the felt paper and the wall substrate. The way to prevent this from occurring was the development of a hard plastic material that is approximately 1" thick and is slightly wider than the window opening. The walls below the windows or doors are cut open and the framing is notched so that this component can be set into the area below the window. The door, on the other hand, must be pulled out and then re-set. When the drain is installed under a door, it is called a pan flashing. It captures water under the door and drains it out of the wall. It works on the same principle as the SILL FLASHING that is placed under windows.



Weep Screed- A weep screed is a horizontal water drainage collector located at the bottom of the ACMV. It is installed prior to the installation of the ACMV. It is normally vinyl or aluminum and is secured to the bottom of the wall framing into the sill plate of the exterior wall. The purpose is to collect water that may have gotten behind the exterior surface of the ACMV material and to drain it safely out of the wall assembly. It is required by all companies that manufacture ACMV.

FOUNDATION WEEP SCREED INSTALLATION DETAIL

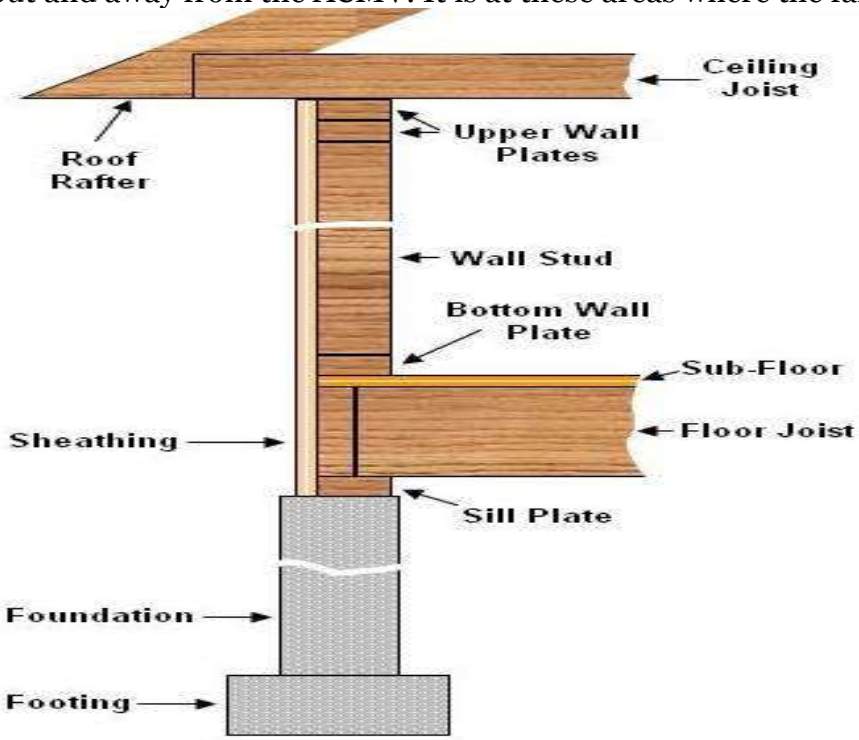


In the past 20 years there have been concerns raised by inspectors and other experts in the field of building science concerning the application of ACMV material to house and commercial buildings that are framed with wood studs and wood substrate materials. The concerns are not about the stone being a problem, but rather the installation techniques employed by contractors. At the center of these concerns is the management of the water that will drain across the surfaces of the material in rain and snow events with or without wind.

Water must be drained safely out of the ACMV system so that it cannot access the interior areas of the walls.

The studs, top plates, bottom plates and substrate are collectively referred to in the construction world as the "**wall assembly".**

By not properly installing the materials against the wall assembly, there will be failure. That failure may happen soon after installation, or take several years. It just depends on what the error was and how bad of an error was made by the installation team. Frequently, the errors are related to not providing a way for the water to drain out and away from the ACMV. It is at these areas where the failure occurs.



Once water has accessed the wall assembly a great deal of issues develop; mold growth and structural problems being the greatest of these issues.

There are 5 things that must be accomplished on any ACMV system in order for it to properly function;

1). Substrate preparation
2). Secondary drainage
3). Primary drainage
4). Flashing systems
5). Stone and mortar installation

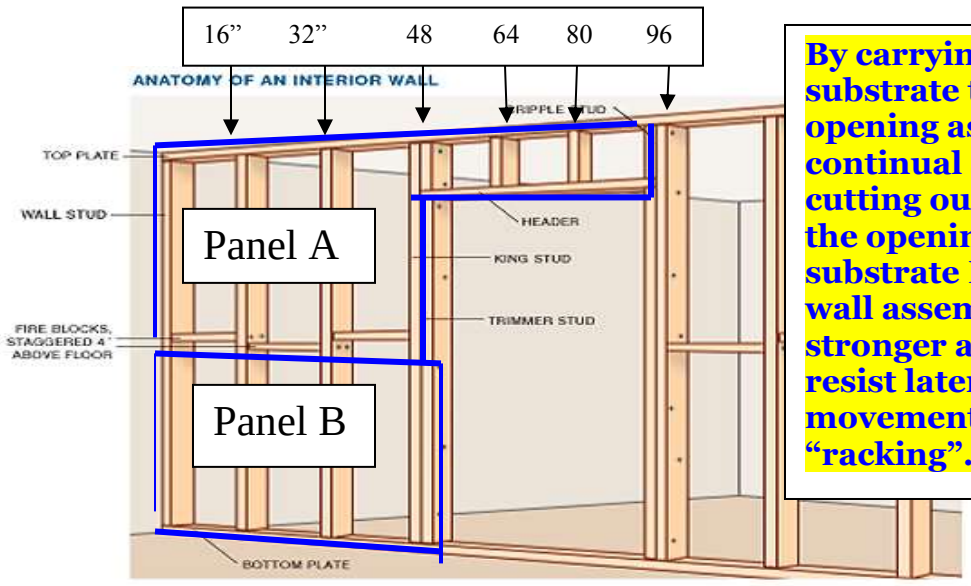
Without any one of these items, an ACMV system will fail. So let's talk about each briefly.

Substrate Preparation

Remember that the substrate is the material that is secured to the exterior side of the wall stud surfaces. It is normally plywood or oriented strand board. There are now new hybrid wall substrate systems like the ZIP SYSTEM TM that have been developed to aid in the drainage of surface water.

The substrate is typically nailed into the studs and there is a "nailing schedule" required by the manufacturer and building code. A nailing schedule is the amount, type, and location of the nails used to secure the substrate to the stud surfaces. Too few nails or under-sized nails can lead to the substrate being pulled off the studs.

The substrate must also be installed so that where it starts and stops is on the center of a stud. The typical substrate size is 48" wide and 96" tall because most walls are framed using the 16" on center and 96 and 48 are divisible by 16". Some wall assemblies have the substrate vertically and other wall assemblies have the substrate installed horizontally. I believe that best practice in framing is to have the substrate installed so it is horizontal and the 96" length is perpendicular to the vertical studs.



By carrying the substrate through the opening as one continual sheet, and cutting out the top of the opening from substrate Panel A, the wall assembly is stronger and will resist lateral movement called "racking".

Secondary Drainage system

The substrate can be covered with several types of material that act to help drain away water before it gets to the substrate or in between the studs. There are several manufacturers that produce “building wraps”. The composition of these wraps is a breathable paper product that resists water permeation. These are secured to the substrate with wide head fasteners or staples. There are securement “schedules” that must be followed for these products as well. Some of these nail heads are made of plastic, some are galvanized metal or stainless steel. All must be corrosion resistant.

There is also a liquid plastic coating made by several manufacturers that can be painted on the substrate. These are very good but any gaps in the substrate must be sealed prior to the application of these liquid coatings.

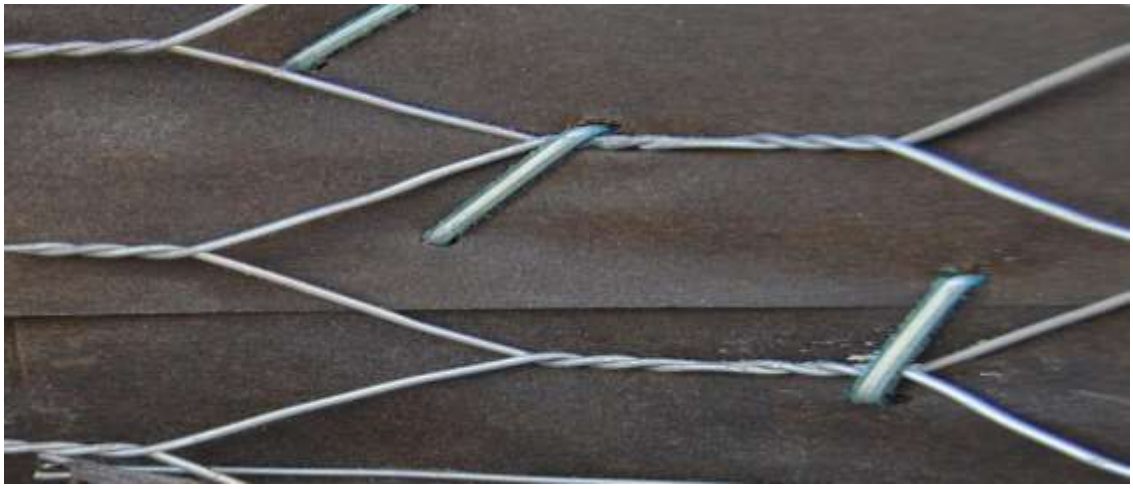
Additionally, acrylic and elastomeric coatings are offered on the market. Go to www.stocorp.com for additional information.

This secondary drainage material that is the “last line of defense” for the wall assembly and is common with not only ACMV but also most other exterior wall facades. This material or something that performs in a similar fashion is now a requirement by building codes.

Primary Drainage System

With ACMV, there is felt paper used as the primary drainage system. The felt paper is stapled to the substrate, (over the secondary drainage system, and then the steel mesh is secured to the substrate through the mesh and felt paper and secondary drainage material.

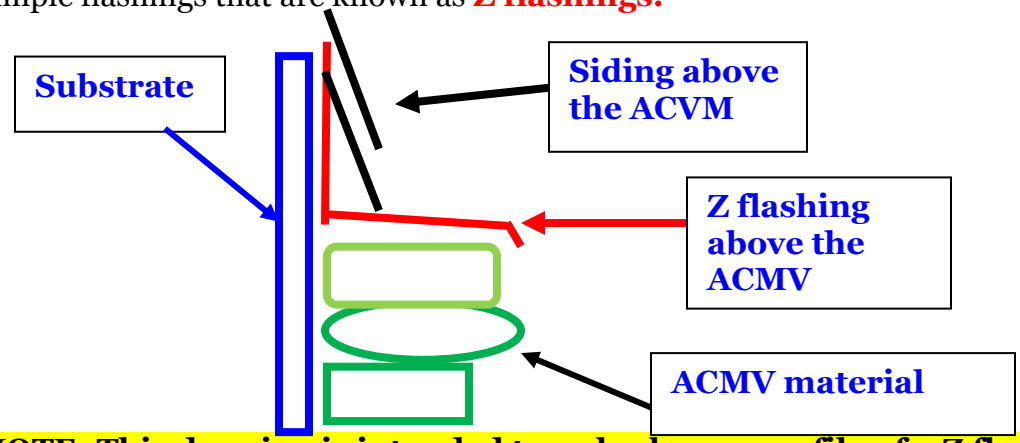
The key to proper non-leaking application is to be sure that the felt paper is lapped over the lower layer in all locations on the wall, and that there are no rips or voids in the felt material.



Flashing Systems

A very important component to successful installation of the ACVM or most any material that is a part of the exterior building envelope is the installation of correct flashing systems. The lack of flashing or the installation of flashing incorrectly is the #1 cause of ACVM and other wall cladding failures in the experience of this inspector. Because of the omission of one $5.00 flashing, I have seen well over $500,000.00 in wall damage.

So what are flashings? These are polymer-based (rigid plastic) or metal, (stainless steel or copper) materials. All flashings are installed where windows, roof lines, and ACVM intersects with other materials. They are installed horizontally at the top of the ACVM or along the bottom of ACVM where it intersects a floor or porch. Flashings can be installed vertically at the wall intersections. There are many application and many types of flashings from simple flashings that are known as **Z flashings.**



NOTE: This drawing is intended to only show a profile of a Z flashing. There are primary and secondary materials behind the Z flashing and over the substrate that are not shown in this diagram.

The one important thing to remember when installing any flashing or exterior material on a building envelope is:

TOP OVER BOTTOM

Because **water runs down the surface of a vertical wall,** all exterior flashings and wall material must lap over each other with the upper material lapping over the lower material. This sounds simple, but I have seen many situations where this simple rule has been omitted.

Two of the thousands of examples of omitted flashings are shown below. Photo A is a column on a porch. It has EIFS on the surface of the substrate below the support column. The missing flashing at the top, where the column base is extended beyond the base of the column with no means to drain water, has caused the column base to become saturated with water that accessed at the location shown in the Photo A. Photo B shows a missing horizontal flashing at the ACMV, and water access is cracking the material. A flashing cut into the bed mortar of the brick is needed. That flashing should lap over the top of the stone on the horizontal plane. This will stop water access behind the ACMV stone.

Some of the **various flashing systems** are noted below:

Kick Out Flashings- Roof intersections with walls at the eave line.

Base Flashings- Flashings where the wall material terminates on a flat surface such as a porch

Head Flashings- These are flashings that are installed above windows and other wall penetrations.

Apron Flashings- Flashings that are installed at the down roof surface of a dormer or chimney.

Z flashings- Flashings that are installed on a horizontal intersection of two exterior wall surfaces to insure that the rain will drain away from the lower material at the horizontal seam.

There are many other flashings that are installed to prevent water access into the building envelope. These above are some of the most common. The reason for the flashings is the same, to **seal the wall material from water intrusion**.

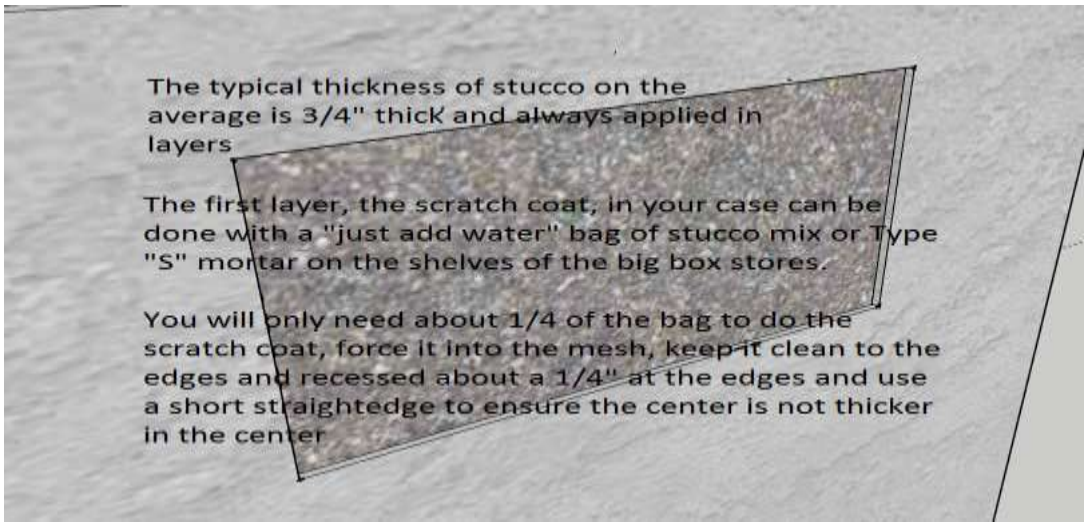
Stone and Mortar Installation

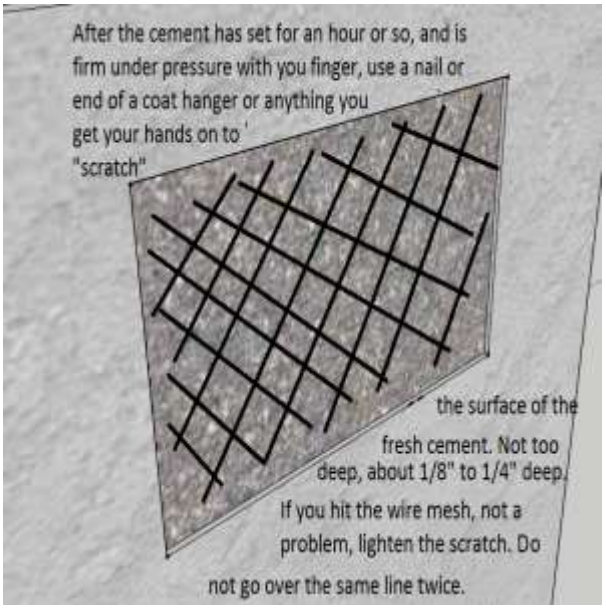
With the primary and secondary drainage systems in place, the next part of any ACMV installation is to install the first coat of cement to the exposed steel mesh. This is done with a trowel and consists of S type mortar and additives depending upon the weather conditions. The first coat is often referred to as the "Scratch Coat".

The thickness of the scratch coat should be about 3/8" and the coat should be dry prior to the installation of the ACMV stones. This is not dis-similar to the application of stucco. The coating is applied in layers.

The ACMV stones are applied with Type N mortar and it is applied to the back of each ACMV stone and then the ACMV stone is pushed against the scratch coat mortar where it bonds to the scratch coating.

There are several types of ACMV stone and the application has some variables in the application process. ***The above explanation of the ACMV is intended as a general outline of application only***. Every stone application should include a check of the manufacturer requirements that come with the ACMV stone prior to any application of any ACMV stone.


The typical thickness of stucco on the average is 3/4" thick and always applied in layers
The first layer, the scratch coat, in your case can be done with a "just add water" bag of stucco mix or Type "S" mortar on the shelves of the big box stores.
You will only need about 1/4 of the bag to do the scratch coat, force it into the mesh, keep it clean to the edges and recessed about a 1/4" at the edges and use a short straightedge to ensure the center is not thicker in the center


After the cement has set for an hour or so, and is firm under pressure with you finger, use a nail or end of a coat hanger or anything you get your hands on to '
"scratch"
the surface of the
fresh cement. Not too
deep, about 1/8" to 1/4" deep.
If you hit the wire mesh, not a
problem, lighten the scratch. Do
not go over the same line twice.

Some of the ACMV is applied tightly at all joints with no mortar observed. Some is installed with gaps in the stones with mortar between the stones so that they appear to be similar to a real mined stone. All are adhered to the scratch coat and then "stuck" against the scratch coat with N type mortar.

This has been a general discussion of the background of ACMV and several of the components that are related to the material. This discussion is not intended to be technically exhaustive. The intention is to give the reader some understanding of ACMV and the important items that are related to the application of the material. An expert in this material and/or the manufacturer of the material should be consulted prior to any application of ACMV.

Finegan Inspection Services, Inc.
ASHI Member #033511 21 years
Professional inspector 26 years
Exterior Design Institute member OH-17- 19 years
by Terrence P. Finegan