Moisture Management in Masonry Buildings

Unitized flashing provides an integrated design solution

Sponsored by Mortar Net® USA, Ltd. | By Celeste Allen Novak, AIA, LEED AP

Masonry construction, one of the oldest building systems in the world, requires a complex integration of a variety of elements to control moisture. The construction of a masonry building requires the knowledge of how this material weathers and reacts to seasonal changes such as snow, sleet, wind-driven rain, and humidity. Ancient civilizations building in equatorial zones using 3-foot-thick walls did not have to worry about a freeze-thaw cycle when they chose masonry, stucco, and brick as their most common building material. However, as civilization moved north to more temperate climates, new construction methods reduced the impact of moisture from seasonal temperature variations on buildings. The modern development of wood and steel structural frames with masonry cladding included the development of flashing systems that can expel moisture from these new building enclosures. The main line of defense that protects a wall system from moisture damage is in the construction detailing of wall flashing.

Early technical manuals such as the AIA’s Ramsey and Sleeper Architectural Graphic Standard as well as 21st century editions provide numerous details for preventing moisture damage in masonry and masonry clad buildings. In the 1939 Brick Engineering Handbook of Design, the author states that “at the outset, it might be stated that no flashing at all is better than poor flashing.”

The International Masonry Institute and the Building Enclosure Council provides information on codes, technical and non-technical bulletins on materials and techniques. Flashing materials and assemblies require code-compliant standards for durability, plasticity, and permeability. With all of this support, the evidence is clear that the variety and compatibility of moisture-proofing materials, flashing, expansion and control joints are providing many choices for successful field applications of flashing in masonry buildings.

Contractors are required to monitor the installation and compatibility of numerous materials specified by design professionals who are often not aware of the specific field conditions during construction. A lot can and
does go awry when building a masonry building. There is also an increasing emphasis on the design of high-performance buildings for energy efficiency and durability as part of a sustainable design portfolio. To design a moisture-proof, high-performance building, architects need to carefully detail and specify all of the components that are part of this system. They may also want to choose from a new variety of engineered products that unitize some of the basic components of the flashing system to improve the constructability of masonry wall systems. As architects explore new forms: curved walls, canted overhangs, multifaceted edges, and masonry cladding in high-rise buildings, the integration of materials for moisture proofing wall systems can be an important design component. Three-dimensional detailing as part of information modeling has helped develop a more focused look at the many corners, breaks, and openings in modern buildings. “Designers sometimes forget how beautiful details are!” says Jim Stevens, AIA, an associate professor of architecture at Lawrence Technological University. Stevens reports that the plans for the renovation of a courthouse in St. Louis displayed corner boots, end dams, and flashing pieces that could have been exhibits of modern sculptures. A review of the components in wall flashing will show how unifying the components allows for easier installation and better moisture control in buildings.

MOISTURE AND MASONRY
Masonry is a porous material and all masonry buildings absorb moisture. From roof to foundation, what may appear to be an impenetrable building component is in fact, a system that needs to breathe to expel moisture. Masonry walls are typically constructed with an air gap between the brick veneer or exterior wythe of brick and the structural wall. Brick veneer is primarily decorative and is connected to the structural wall system by metal brick ties. Between the veneer and the structural wall is an air gap that is the “lungs” of the wall system—the place where air and moisture is channeled to be expelled at any place where the solid wall is interrupted by an opening such as a window, an interior or exterior corner and primarily at the end of the vertical wall. The Brick Industry Association (BIA) defines a cavity wall as having a continuous air space. Depending upon the skill of the mason, mortar droppings can fill a wall cavity so the BIA recommends a 2-inch minimum cavity to allow for proper drainage and airflow. However, the BIA Technical Note 21A allows rigid insulation to occupy one-half of the 2-inch cavity creating an even tighter allowance for proper mortar placement.

The most common reasons for excess water in a brick wall cavity can come from:

► Inadequately filled or over-sanded mortar joints
► Extreme acid cleaning
► Design details – Rowlocks or Soldier courses
► Construction materials – weather exposure

A publication of best practices from the 2006 AIA Convention, describes the need for considering moisture penetration as part of an early design phase. “Effective prevention involves implementing a successful water management system, understanding the sources of moisture ingress, and identifying potential problems. Studies have shown that uncontrolled rainwater penetration and moisture ingress are two of the most common threats to the performance of a building’s envelope and together they represent up to 80 percent of all construction-related liability claims in the United States.” Detailing of the drainage system through proper flashing is considered one of the top means of effective moisture management.

EFFECTIVE FLASHING
Flashings are membranes installed within a masonry wall to either prevent moisture infiltration, or divert moisture, which does not penetrate the wall, back to the exterior of the building. Flashing provides a controlled path for water through walls. Unless specified as a unified component, the pieces that comprise a flashing system are membranes, weeps, termination bars, drip edges, and adhesives. Driving rain or sleet and the build-up of condensation on the interior of a masonry wall is directed by gravity to the lowest point in a building. Without flashing, the collection of moisture increases maintenance costs and can even cause building failures. Water can be prevented from getting out of a wall by the omission or incorrect installation of wall flashing and weep holes that can be clogged by mortar. Damage to masonry buildings due to moisture penetration can include efflorescence, spalling, steel stud failures, mold penetration, and even the collapse of the entire wall system.
MOISTURE MANAGEMENT IN MASONRY BUILDINGS

CONTINUING EDUCATION

will specify a material that:

- specifies a flashing system are that the design professional
- lead to higher replacement and maintenance
- and expensive. Lower-cost solutions for building
- particularly in high-rise buildings, is difficult
- match the life of a building. Replacing flashing,
- should not cause staining on the wall and
- mortar, salts, and masonry. Flashing materials
- substrate wall, adhesives, sealants, air barriers,
- for expansion and contraction without cracking
- adhered to the wall with adhesives that allow
- flashing material should be flexible enough to
- be formed and placed on the wall. Flashing is
- adhered to the wall with adhesives that allow
- for expansion and contraction without cracking
- during seasonal changes. The flashing material
- must be compatible with the masonry, back-up
- substrate wall, adhesives, sealants, air barriers,
- mortar, salts, and masonry. Flashing materials
- should not cause staining on the wall and
- should be almost invisible when placed along
- the wall surface.

The estimated life of the flashing should
match the life of a building. Replacing flashing,
particularly in high-rise buildings, is difficult
and expensive. Lower-cost solutions for building
flashing, for example the use of asphalt-
impregnated felts or tar paper, almost always
lead to higher replacement and maintenance
costs for the building owner.

The advantages of selecting a unitized
flashing system are that the design professional
will specify a material that:
- decreases the probability of improper installation
of materials—especially at difficult locations
such as overlaps, rough openings, inside and
outside corners.
- manages mortar damming so water can easily
flow out of the wall cavity.
- prevents air pressure differentials that can
force moisture in the building envelope.
- can specify a material that has recycled
content to help with LEED® certification.
- assists with timely delivery on site.
- provides compatible materials and
prefabricated components for end dams and
corner boots.
- is one product instead of five separately
manufactured and sourced products.
- predetermines overlaps and enhances uniform
installation.
- avoids excessive labor installation costs of
multiple layers of materials.

Unitized flashing systems can be specified
using any of the most common flashing materials
as a membrane. Unitized flashing has pre-
designed laps, screws, weeps, termination bars,
drip-edges, and a mortar collection device that
meets the requirements of the ASTM E-514 water
test. These durable systems are easy to install,
particularly for high-rise buildings as well as
buildings with numerous changes of materials
and wall orientation. New products include
roll flashing with a mortar collection system
directly attached to the flashing membrane,
clean lap spaces, and weeps. This adds to the
ease of installation and reduces the cost of labor.
In addition, the uniform placement of weeps
and the clean edges of the flashing are almost
indiscernible on the building facade.

COMPONENTS OF FLASHING SYSTEMS

There are several components of a flashing system
that needs to be installed and work together for
moisture collection. The flashing membrane is
the material that extends from the inside to the
exterior of the wall system. Mortar collection is
a strategy that in the past has been provided by
a variety of installation techniques but now can
be specified as part of a collection system. In
addition, a flashing system includes weep hole
vents, termination bars, and drip edges—all of
which may be adhered to the wall by screws or
adhesives that must be compatible with a variety
of materials. The latest flashing systems provide
prefabricated corner “boots” and end dams
that allow for more precise fittings at different
dges and corners of the building. All of
these components can be specified in a variety
of materials, and weep hole vents and drip edges
can also be selected by color. One of the advantages
of unitized flashing systems is that these components
can be easily coordinated and specified.

ADVANTAGE OF UNITIZED FLASHING MATERIALS

When installed at the base of a masonry wall,
flashing spans from the exterior to the interior
of that wall. Flashing covers the gap between
the masonry and the substrate backup wall or
in the case of a single wythe system, covers the
open cells in blocks. Flashing should primarily
be durable and resist and direct moisture as
part of a complete system. Flashing materials
should be tough enough to resist puncture by
a mason with a trowel as subsequent layers of
mortar and masonry are added to the wall. The
flashing material should be flexible enough to
be formed and placed on the wall. Flashing is
adhered to the wall with adhesives that allow
for expansion and contraction without cracking
during seasonal changes. The flashing material
must be compatible with the masonry, back-up
substrate wall, adhesives, sealants, air barriers,
mortar, salts, and masonry. Flashing materials
should not cause staining on the wall and
should be almost invisible when placed along
the wall surface.

The estimated life of the flashing should
match the life of a building. Replacing flashing,
particularly in high-rise buildings, is difficult
and expensive. Lower-cost solutions for building
flashing, for example the use of asphalt-
impregnated felts or tar paper, almost always
lead to higher replacement and maintenance
costs for the building owner.

The advantages of selecting a unitized
flashing system are that the design professional
will specify a material that:
- decreases the probability of improper installation
of materials—especially at difficult locations
such as overlaps, rough openings, inside and
outside corners.
- manages mortar damming so water can easily
flow out of the wall cavity.
- prevents air pressure differentials that can
force moisture in the building envelope.
- can specify a material that has recycled
content to help with LEED® certification.
- assists with timely delivery on site.
- provides compatible materials and
prefabricated components for end dams and
corner boots.
- is one product instead of five separately
manufactured and sourced products.
- predetermines overlaps and enhances uniform
installation.
- avoids excessive labor installation costs of
multiple layers of materials.

Unitized flashing systems can be specified
using any of the most common flashing materials
as a membrane. Unitized flashing has pre-
designed laps, screws, weeps, termination bars,
drip-edges, and a mortar collection device that
meets the requirements of the ASTM E-514 water
test. These durable systems are easy to install,
particularly for high-rise buildings as well as
buildings with numerous changes of materials
and wall orientation. New products include
roll flashing with a mortar collection system
directly attached to the flashing membrane,
clean lap spaces, and weeps. This adds to the
ease of installation and reduces the cost of labor.
In addition, the uniform placement of weeps
and the clean edges of the flashing are almost
indiscernible on the building facade.

COMPONENTS OF FLASHING SYSTEMS

There are several components of a flashing system
that needs to be installed and work together for
moisture collection. The flashing membrane is
the material that extends from the inside to the
exterior of the wall system. Mortar collection is
a strategy that in the past has been provided by
a variety of installation techniques but now can
be specified as part of a collection system. In
addition, a flashing system includes weep hole
vents, termination bars, and drip edges—all of
which may be adhered to the wall by screws or
adhesives that must be compatible with a variety
of materials. The latest flashing systems provide
prefabricated corner “boots” and end dams
that allow for more precise fittings at different
dges and corners of the building. All of
these components can be specified in a variety
of materials, and weep hole vents and drip edges
can also be selected by color. One of the advantages
of unitized flashing systems is that these components
can be easily coordinated and specified.

COMPOSITE, UNITIZED FLASHING CHOSEN FOR HAMPTON UNIVERSITY

Architect George Faulkner Jr., AIA, senior
designer and project architect for the Hampton
University Student Dining Facility worked with
moisture consultant, Stephen Hentz, P.E., of
Hentz Engineering, to detail this important
 campus building. The dining hall will serve as
an institutional focal point that will be located
on the shoreline of the Hampton River on the
 campus of Hampton University overlooking
downtown Hampton, Virginia.

The 80,000-square-foot facility will be
 housed on two levels with the second floor set
back from the main façade to create a dramatic
two-story atrium along the waterfront. The
main floor will house a central dining area with
food service kiosks around the perimeter of the
atrium. The second floor will house a full-service
market-style food court and administration
areas. The design will also include exterior
eating areas with views of the river. To maximize
the benefit of its prime waterfront location, the
composition of the building will be designed

Photo by George Faulkner

Controlling water penetration on campus
buildings was important when designing a
building that is clad in brick, glass, and
precast concrete.

During construction, site visits were
performed to observe the installed components
for compliance with the project documents.
Working with a moisture proofing consultant,
the architect commented that the “choice
of unitized flashing was presented by the
consultant who had previous experience with
this unique product.” This selection is part of
the overall requirements to design a long-
 lasting, permanent campus facility.
Membranes
The choice of the flashing material is important when specifying any flashing system. There is a wide variety of materials to select from for a typical flashing system as well as for a unitized flashing system, including the following products that have been re-engineered to meet higher performance standards. According to Steven Fechino, engineering and construction manager at Mortar Net® USA, Ltd., some of these types of flashing include the following:3

Copper laminate. Copper flashings are one of the oldest of all flashing materials and one of the most permanent. New systems include a laminated mesh of polyethylene on both sides of the copper. This durable product is almost impossible to damage with a trowel during installation. Copper flashing can cause staining on masonry if not properly detailed. Many new copper laminates are compatible with most building products as they do not contain asphalt as a binder.

Stainless steel. This high-end product is usually specified for institutional buildings and those buildings meant to be a legacy for future generations. One of the most expensive flashing materials, installation is labor intensive and requires bending, soldering, mechanical fasteners, and adhesives.

Rubberized asphalt. One of the most common types of flashing used by masons and often is installed with a “peel and stick” placement on the back up wall. The type of primer used with this product as well as proper installation is the key to successful moisture management. It is sensitive to ultra-violet rays and can be damaged if left exposed during construction. Rubberized asphalt can also be incompatible with polyvinyl chloride (PVC) molds used for corners and end dams. The plasticizers in the PVC may leach into the asphalt and reduce the plasticity of the asphalt over time.

Thermovinyl plastics with non-migratory plasticizers (PVC): The current PVC flashing materials have been developed from products well-tested and used for roof flashing. This product is durable, flexible, and strong. It is compatible with many polyurethanes, polyethers, and butyls.

Thermoplastic polyolefin (TPO). This flexible membrane has a 30-year life span when installed on a roof and almost unlimited life span when used as wall flashing. The laps on this product can be sealed with a butyl rubber or primed polyether adhesives as well as with heat welding.

Ethylene propylene diene monomer (EPDM). Another roofing material that has migrated for use in wall flashing, EPDM is durable, flexible, and easy to install but may need to be specified with matching EPDM components to avoid incompatibility with some PVC corner boots and end dams.

Comparison of Common Flashing Material Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>Durable</td>
<td>Difficult to bend. High installation costs. Must be preformed at factory. Usually requires steelworkers for installation.</td>
</tr>
<tr>
<td>Cold-Rolled Copper</td>
<td>Durable, flexible</td>
<td>May leave stains</td>
</tr>
<tr>
<td>Lead-Coated Copper</td>
<td>Easier to form</td>
<td>Lead-coated, does not stain</td>
</tr>
<tr>
<td>Galvanized</td>
<td>Widely accepted</td>
<td>Will deteriorate in acidic environment</td>
</tr>
<tr>
<td>Copper Laminates</td>
<td>Easier to form and join than metals</td>
<td>May tear. Asphalt degrades in sunlight.</td>
</tr>
<tr>
<td>EPDM (Man-made rubber)</td>
<td>Not affected by UV rays, good corrosion resistance, tear and puncture resistance</td>
<td>Requires adhesives for bonding. More difficult to work with than rubberized asphalt, resulting in higher labor costs.</td>
</tr>
<tr>
<td>Rubberized Asphalt Flashing System</td>
<td>Flexible at low temperatures, excellent tear/puncture, self-sealing around small holes</td>
<td>Affected by UV rays</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>Not recommended for through-wall flashings (BIA)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Mortar Net® USA, Ltd.

Photo courtesy of Mortar Net® USA, Ltd.

Multicolored weep vents blend in and are less noticeable along the face of a building.

See endnotes in the online version of this article.

Architect Celeste Allen Novak, AIA, LEED AP, specializes in sustainable design and planning in Ann Arbor, Michigan.

Innovation by experienced masons plus superior sales and technical support have established Mortar Net® USA, Ltd. as the leader in developing and providing moisture management solutions for masonry construction. www.mortarnet.com

Reprinted from the October 2012 issue of Architectural Record.