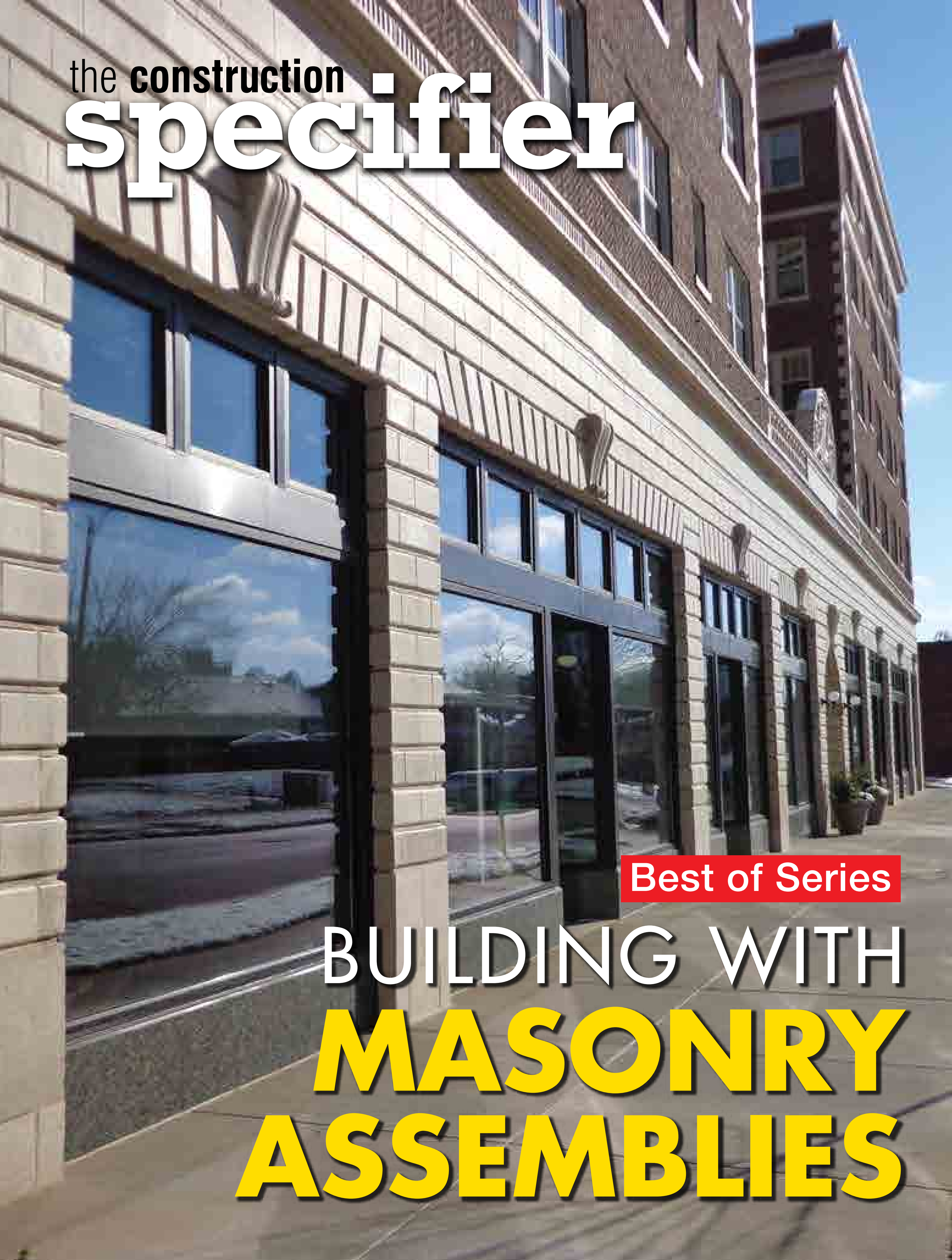

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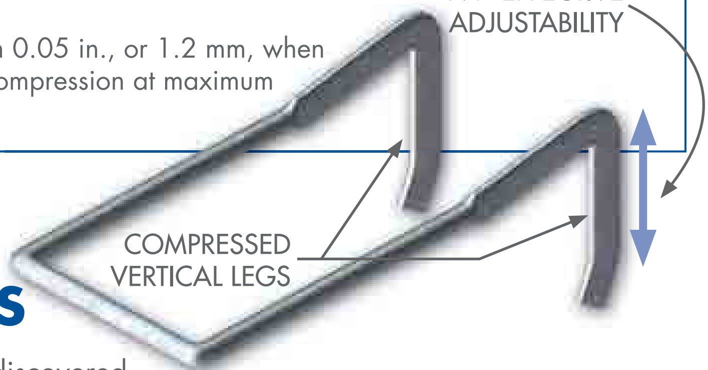

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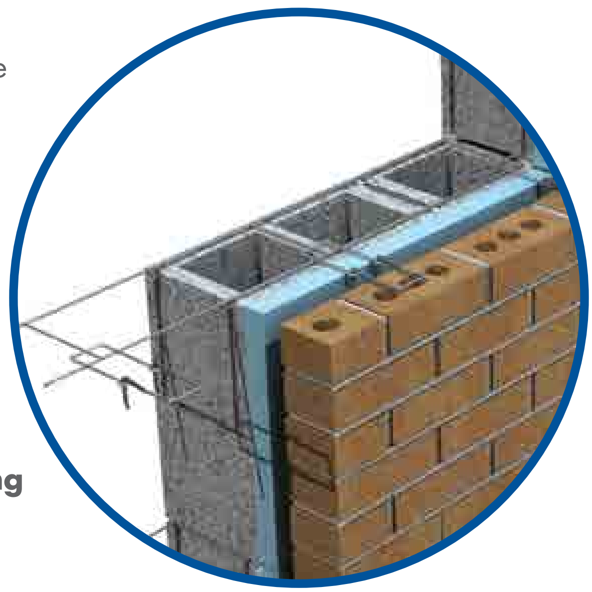

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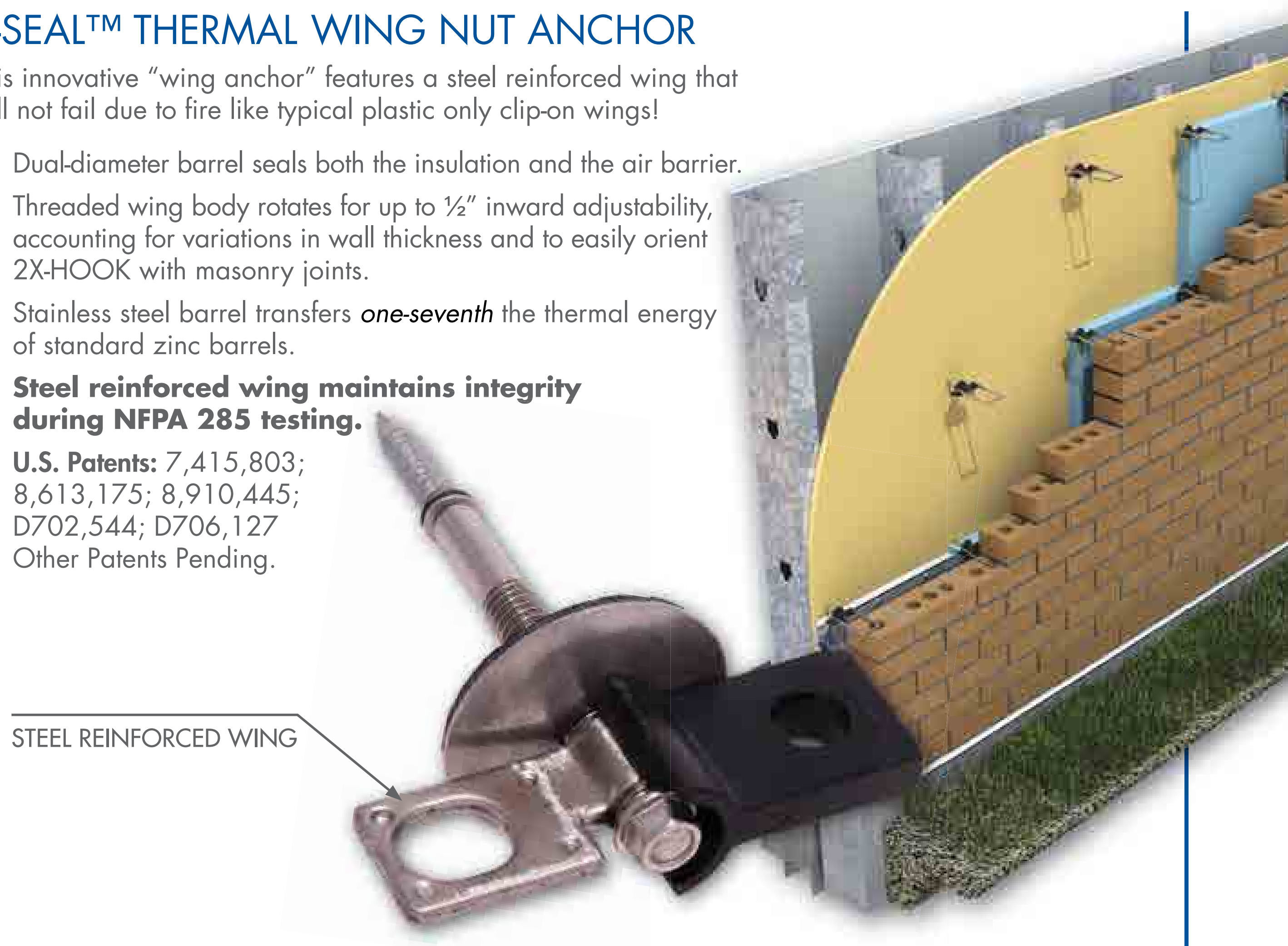

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Building with Masonry Assemblies

Part One

Masonry and Roofing Flashing
A closer look at the interface

BY ANTHONY J. KATONA, CDT

Masonry and Roofing Flashing

A closer look at the interface

Photo © BigStockPhoto

THE IMPORTANCE OF UNDERSTANDING THE FLASHING DESIGN PRINCIPLES AND INSTALLATION REQUIREMENTS BETWEEN THE MASONRY WALL ASSEMBLY AND THE ROOF FLASHING SYSTEM CANNOT BE OVERSTATED. ALL TOO OFTEN, THE EXTERIOR MASONRY WALLS OF A BUILDING STRUCTURE ARE THOUGHT OF AS BEING WATERTIGHT AND REQUIRE LITTLE OR NO MAINTENANCE. THIS PERCEPTION COULD NOT BE FARTHER FROM THE TRUTH. IN FACT, MASONRY WALLS ARE VERY POROUS AND TAKE ON WATER INTO THE WEEP CAVITY. THE PRIMARY PURPOSE OF A PROPERLY DESIGNED THROUGH-WALL FLASHING IS TO PROVIDE AN OUTLET FOR THE ACCUMULATED WATER TO EVACUATE THE CAVITY.

This author's goal is to effectively communicate how critical it is to have the correct design and installation of the interface flashing assembly. The article uses a hypothetical example—an application on a low-slope commercial ethylene propylene diene monomer (EPDM) assembly from the roof line and above. The proper location of the interface assembly for this article is set at the base of a masonry veneer wall.

Regardless of whether the masonry is a rising wall or a parapet, the design of the detail of the through-wall flashing assembly characteristically remains the same. The author prefers to use a combination of 16-oz. lead-coated copper sheet metal flashing and an EPDM membrane. This technique has proven to function very well, even under the most extreme weather conditions, such as sustained wind-driven rainfall and wet snow.

In this article's example, there is a point in the construction process where the roof base flashings join together with a masonry wall. While it is common knowledge all roof systems require flashing assemblies to remain watertight, the overall condition of the masonry wall system is rarely given its due attention—it is frequently overlooked altogether when a roof system is being installed, replaced, or reroofed. The exposed portion of the masonry wall system typically includes any portion of a rising wall or a parapet wall constructed above the roof line.

Finding causes of failures

When a roof leak is reported, it is often the case the roof has nothing at all to do with the leak. During these times, the masonry system rising above the height of the roof flashings needs to be evaluated. Frequently, this type of survey is provided by a professional building envelope/commercial roof consultant.

The selected consultant must be highly skilled in the craft of assessing and determining the source of active leaks in order to adequately and properly evaluate the conditions. This inspection will aid in the determination of what actions need to be performed.

Once the mechanism of failure has been properly identified, the consultant must also be experienced enough to develop a specification for the scope of work necessary to remediate the problem. The effort may include a non-invasive visual inspection of the roof/wall interface assembly. Depending on the outcome of the initial assessment, it may be necessary to take a closer look.

The primary role of these flashings is to take two independent construction systems and join them together to make them watertight. Additionally, these flashings must also provide the means of egress for any moisture accumulating within the weep cavity to drain out. This clearing of the moisture from the weep cavity is essential to keep the building dry.

Figure 1 (page 8) shows one of many correct ways to properly construct a through-wall flashing assembly. This detail is designed specifically for when new interface flashings are needed at the base of a masonry veneer wall, and wherever masonry will be extended over the interface flashing assembly.

Although the flashings must be accurately designed, it is just as important they be correctly installed. Therefore, there must be open dialogue between the owner, designer, specifier, contractor, and subcontractors involved in the process of achieving a successful outcome.

One excellent method of doing this is to hold mandatory pre-construction meetings that include the project superintendent as well as the project foreperson (for any portion of the work). By doing so, the personnel actually leading the performance of the work in the field are properly instructed in the procedures called for during the project.

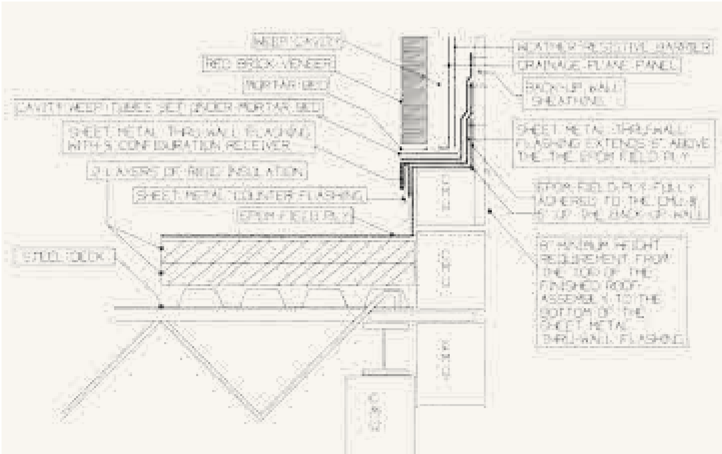
Another highly recommended way is to have a product manufacturer's representative or a knowledgeable building envelope/commercial roof consultant onsite before the start of the project. The purpose of holding this meeting is for the product representative to perform a demonstration for the construction team (on a mockup assembly). This typically includes the proper installation techniques used to successfully meet the project requirements.

In this project, lifting back the improperly installed sheet metal counterflashing reveals the height of the base flashings are improperly installed and terminated less than 200 mm (4 in.) higher than the finished roof surface.

Images courtesy Alliance Roof Consultants

The two photos above provide close-up views of an improperly installed and deteriorated sheet metal through-wall flashing assembly. Inadequately installed sheet metal and surface-mounted counterflashing can be seen.

Figure 1



This CAD drawing shows one of many correct ways to properly construct a through-wall flashing assembly.

The photo above shows an unsuccessful attempt at controlling the leak via the use of a black polypropylene sheet mechanically fastened to the inside face of the outer perimeter masonry parapet wall.

An example of a properly installed through-wall flashing assembly. The 400-mm (8-in.) minimum height requirement of the base flashing has been met.

Design principles

The design principles should be specific to the project. This effort may require a closer look at the individual project elements that affect the final design, including the interface flashing assembly. Here are some good general rules:

1. Open communication between the design team and the construction team is crucial.
2. One must meet the manufacturer's specific requirements for minimum base flashing height.
3. Backup walls must be sufficient to secure the new through-wall flashings.
4. To avoid any discrepancy, the roofing contractor should be assigned responsibility of installing the specified sheet metal through-wall flashings and the EPDM membrane field and flashing plies.
5. The reason flashings terminate a minimum of 200 mm (8 in.) above the surface of the finished roof system is because this is where the manufacturer's warranty ends.
6. Typically, there are certain site conditions on construction projects that require adjustment in the field.
7. Any variations should be addressed by the both the design and the construction teams.

Installation requirements

Installation is just as important to the flashing systems as it is to follow all applicable building codes, safety programs, and the contract for construction. Careful supervision and diligent coordination between the contractor and the subcontractor is essential for proper installation of these flashings. Knowing and executing the appropriate sequencing of the moisture management system products is mandatory.

Installation of the specified products must follow the manufacturers' installation guidelines for the materials being applied. The sheet metal flashing details are to be measured in the field so they are congruent with the as-built profile of the existing concrete masonry unit (CMU).

The performance of the water-resistive barrier (WRB) aids in keep the building dry. The through-wall flashing assemblies provide the means of egress and allow for any accumulated water to evacuate the weep cavity. End dams must also be installed at each end of the sheet metal flashing to prevent water from migrating outside of the confines of the newly installed flashings.

Benchmark milestones are put in place in order to document the integrity of the flashing assemblies. This documentation is required at each one of the bulleted items listed on the next page, which consist of the following individual elements installed in the order in which they are recorded:

Deteriorated mortar joints on the outside wall pipe chase. (The access panels were built into the pipe chase structure.) The photo on the right shows inside the chase—note the the standing water at the bottom of the photo, along with the efflorescence on the exterior portion of the outside parapet wall.

Note the condition of the concrete masonry unit (CMU) mortar joints, along with the dissimilar base flashing materials at the base of the outer perimeter parapet wall.

- fully adhered EPDM field ply;
- sheet metal through-wall flashing receiver for the base flashing counterflashing;
- fully adhered EPDM flashing ply;
- high-quality permeable WRB;
- weep tubes installed underneath the setting bed of mortar for the first course of brickwork; and
- drainage plane with a shiplapped fabric that is extended over the back edge of the weep tubes.

The flashings must be fully adhered and secured to the backup wall with appropriate fasteners. In this example, the flashings are what allows for the accumulated moisture to drain out of the weep cavity. These flashings must be inspected prior to any masonry material being extended over them. This is done to document the integrity of the of the installed through-wall flashing system assemblies, step by step.

Each element must be adhered and fastened to the backup wall with approved fasteners. Those assemblies must then be covered over with a high-quality, permeable WRB, which is shingled into place starting from the top of the CMU base platform, and working from the low point to the high point of the parapet and/or the rising wall.

The installation calls for all lapped seams to be horizontal, and taped using the tape manufactured specifically by the WRB producer. The water-resistive barrier gets fitted to the contour of all exposed areas of the rising/parapet wall sheathing. This material is then fastened with the approved fasteners following fastener density protocol. The drainage plane system then gets installed, covering all exposed areas of the WRB.

A close-up view of a properly installed through-wall flashing assembly. There is lead-coated copper sheet metal flashing covering over, and soldered above, a field condition at the left-hand portion of the assembly. Additionally, note the end dam at the upper right-hand portion of the photograph.

Southeast corner of the mechanical room elevation structure. Note the dissimilar materials added to the bottom and the surface-mounted counterflashing at the base of the door threshold. In the close-up at right, the counterflashing has been taken apart; the original sheet metal through-wall flashing is buried in the wall behind the new base flashing material.

Each of the previously mentioned benchmark milestones in the process of construction requires photographic and written accounts that must be documented by the consultant or an independent quality assurance (QA) observer. This document must be distributed to all parties on the same day the report is prepared.

Case study example

The following section describes an example of a situation this author encountered where the interface flashings failed due to poor workmanship and/or product deficiencies, with limited reliance on the specified design protocol.

This project took place on an existing structure. Two roofs were removed and replaced in as many years, with the same leak remaining unchanged. In order for the base flashings to be specifically included in the manufacturer's warranty, they must be a minimum of 200 mm (8 in.) higher than the height of the finished roof surface. Consequently, if the base flashings do not meet the 200-mm minimum height requirement (as it was in this case), then any leakage that would result at or around these base flashings would not be covered under the manufacturer's warranty. This resulted in the manufacturer denying the warranty claim by the owner (and, to be clear, the manufacturer was correct—based on the terms and conditions of the warranty). Therefore, the owner was left with a leaking roof without any recourse other than to replace the roof at their own expense.

Upon removal of several bricks in a random location, it was clearly evident this leak was a result of a previously improperly installed through-wall flashing found to be 'buried' in the wall behind the existing modified-bitumen (mod-bit) base flashings and the sheet metal counterflashing that was also improperly installed. This leaking condition was so severe that whenever there was a sustained wind-driven rain, the roof would begin to 'float' from the surface of the concrete roof deck.

The approach taken to eliminate the leakage on this project involved removing all existing brickwork necessary to properly install a new EPDM-clad sheet metal through-wall flashing at the interface flashing transition area.

This approach required the physical removal of the brickwork to gain access to the existing improperly installed sheet metal through-wall counter flashings. It also included the removal of all brickwork around the entire outer perimeter walls on the main building, and at all interior perimeter walls of stair tower elevation structures.

Additionally, the entire roof was removed and replaced, this time utilizing the new through-wall flashings. On completion of the replacement roof system, the previous leaking condition was successfully eliminated.

Conclusion

This article is aiming to communicate the importance of the correct design and installation method of an interface through-wall flashing assembly between a masonry wall and a roof. Understanding the design principles of keeping the building envelope watertight, whether this is new construction or a replacement project on an existing building structure, are critical. **CS**

Close-up view of the interior side of the CMU parapet wall. Note the base flashings installed over the original through-wall flashing and the condition of the mortar joints. At right, one can see the top of the probe is touching the original sheet metal through-wall flashing. Also, note the original through-wall is buried in the wall behind the outermost base flashing material.

ADDITIONAL **INFORMATION**

Author

Anthony Katona, CDT, is the president of Alliance Roof Consultants. He has been providing professional services as a building envelope and commercial roof consultant since 1999. With construction experience spanning more than 25 years, Katona has extensive experience in general contracting, commercial roof consulting, and building envelope consulting. He has served as a member of the Editorial Advisory Board of *The Construction Specifier*. Katona can be reached via e-mail at alliancerc@comcast.net.

Abstract

The principles of design of interface flashings, and the installation techniques necessary to install them properly, are often given very little attention, or are overlooked altogether. When developing the proper installation methods of these critical elements, a thorough understanding of how these independent flashings work is necessary. This article examines the importance of installing the flashing assemblies in the proper way so they perform as intended.

MasterFormat No.

04 22 00–Concrete Unit Masonry
07 60 00–Flashing and Sheet Metal

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B2010–Exterior Walls
B3010–Roofing

Key Words

Divisions 04, 07
Flashing
Masonry
Roofing

Building with Masonry Assemblies

Part Two

Understanding Challenges with Adhered Masonry Veneer

Knowledge is key

BY PAT CONWAY, CSI, AIA

Understanding Challenges with Adhered Masonry Veneer

All images courtesy International Masonry Institute

ADHERED MASONRY VENEER ASSEMBLIES ARE GAINING A GREATER SHARE OF THE BUILDING ENCLOSURE MARKET BECAUSE ARCHITECTS AND BUILDING OWNERS LIKE THEIR APPEARANCE, THIN PROFILE, LIGHTWEIGHT FEATURES, AND POTENTIAL FOR COST SAVINGS. HOWEVER, DESIGNING AND CONSTRUCTING THESE EXTERIOR WALL SYSTEMS IS BECOMING MORE COMPLEX WITH A WIDER ARRAY OF CLADDING PRODUCT CHOICES, DRY-STACK CONFIGURATIONS, GREATER EXPANSE OF MATERIAL BEING USED ON EXTERIOR BUILDING ELEVATIONS, CONTINUOUS INSULATION (CI) CHALLENGES, DRAINAGE MAT DEBATES, DURABILITY CONCERNS, AND CONFLICTING INSTALLATION RECOMMENDATIONS TO CONSIDER.

Adhered masonry veneer code requirements are indicated in both Chapter 14 of the *International Building Code* (*IBC*) and Section 6.3 of the referenced national masonry model code and specification, *Building Code Requirements and Specification for Masonry Structures* (*i.e.* The Masonry Society [TMS] 402/American Concrete Institute [ACI] 530/American Society for Civil Engineers [ASCE] 5 and TMS 602/ACI 530.1/ASCE 6). In addition to formally referencing the national masonry model code, *IBC* also mandates designers follow manufacturer installation recommendations (Figure 1, page 14).

Some of these manufacturers have customized installation instructions for their products, while other suppliers simply point designers to ‘typical industry standards’ or guides written by masonry trade associations. Other companies refer to their own proprietary third-party installation recommendations

Since there are multiple design and installation resources available, designers should be careful to compare the various documents for possible conflicts.

Figure 1

Adhered masonry veneer detailing and installation instruction can prove to be a puzzle with potentially conflicting information.

Working with adhered masonry veneer installation can yield benefits for a project, but the project team must truly understand what is involved.

such as their respective International Code Council's Evaluation Service Reports (ICC-ESR). When using thin manufactured masonry units, such reports can serve as reputable sources of objective and definitive information regarding unit properties and installation recommendations. In fact, ICC-ESR, Section 5.1 states:

In the event of a conflict between manufacturer's published installation instructions and this report, this report governs.

When it comes to both natural and manufactured adhered masonry systems, recently published ASTM standards support both the units and their installation. Thin manufactured stone units are now covered by ASTM C1670-14, *Standard Specification for Adhered Manufactured Stone Masonry Veneer Units*, while installation of manufactured stone veneer units is addressed by ASTM C1780-15, *Standard Practice for Installation Methods for Adhered Manufactured Stone Masonry Veneer*. Natural thin stone veneer, on the other hand, is supported by ASTM C1242-15, *Standard Guide for Selecting, Design, and Installation of Dimension Stone Attachment Systems*, under Section 6.7.[1]

For manufactured thin veneer units, common industry guides include the Masonry Veneer Manufacturers Association's (MVMA's) *Installation Guide and Detailing Options for Compliance with ASTM C1780 for Adhered Manufactured Stone Veneer* and the National Concrete Masonry Association's (NCMA's) TEK 20-1 (2014), *Key Installation Checkpoints for Manufactured Stone Veneer*. In addition to these design and installation resources, the International Masonry Institute (IMI) has an informative seminar titled, "Adhered Masonry Veneer Systems," reviewing pertinent building codes, industry literature, different adhered masonry veneer assembly options, and installation photos.

Since there are multiple design and installation resources available, designers should be careful to compare the various documents for possible conflicts. In addition to potentially contradictory design and installation resources, some designers and specifiers take it upon themselves to create unique design and installation parameters with sometimes incomplete or unclear construction documents that can result in inaccurate bids, multiple RFIs, change orders, confusion during the installation process, and schedule delays. This lack of clarity can yield wall performance issues for building owners, hardships for builders, and unexpected project management hours for designers.

When designing adhered masonry veneer systems, it is also important to consider local codes. For example, 10-mm (0.4-in.) drainage mats will be required behind adhered veneer claddings in Canada, and California has its own code citations for adhered masonry veneers applied to schools and healthcare facilities.

Basic exterior wall design concepts

The fact adhered masonry veneer systems differ from typical masonry cavity walls does not mean ignoring basic and proven building science concepts and required building codes of moisture management, energy control, and durability. When using adhered masonry veneers, designers still need to understand:

- how the exterior wall drains and dries when it gets wet;
- ways the exterior wall system controls air, vapor, and associated condensation and energy implications;
- methods to incorporate continuous insulation;
- how the thin cladding products and wall accessories react close to grade or when exposed to de-icing solutions;
- strategies for accommodating material and differential building movement; and
- approaches to selecting durable wall components to create resilient exterior assemblies.

Type of adhered masonry veneers

As adhered masonry veneer systems come with many different types and configurations, along with veneer and internal wall component choices, they should be selected carefully to perform in their respective climate zone. Exterior thin veneer systems can be clad with natural or manufactured brick, natural stone, manufactured stone, ceramic or porcelain tile, fiber-cement products, or other materials. Veneer units can be adhered with traditional mortar, modified mortar, or synthetic materials. Cladding units can be installed as individual units or panelized systems. In more severe climates, the thin veneers industry has learned that polymer-modified mortars or proprietary premium mortars will perform better than traditional mortar.

Further, adhered masonry veneer wall systems can be designed either as a barrier or drainage wall, each with its own considerations.

Figure 2

This four-story, west-facing residential elevation started showing signs of distress on the outside and inside of this home in a couple of years. After six years, the entire adhered veneer system was taken off, including the exterior sheathing and wood framing.

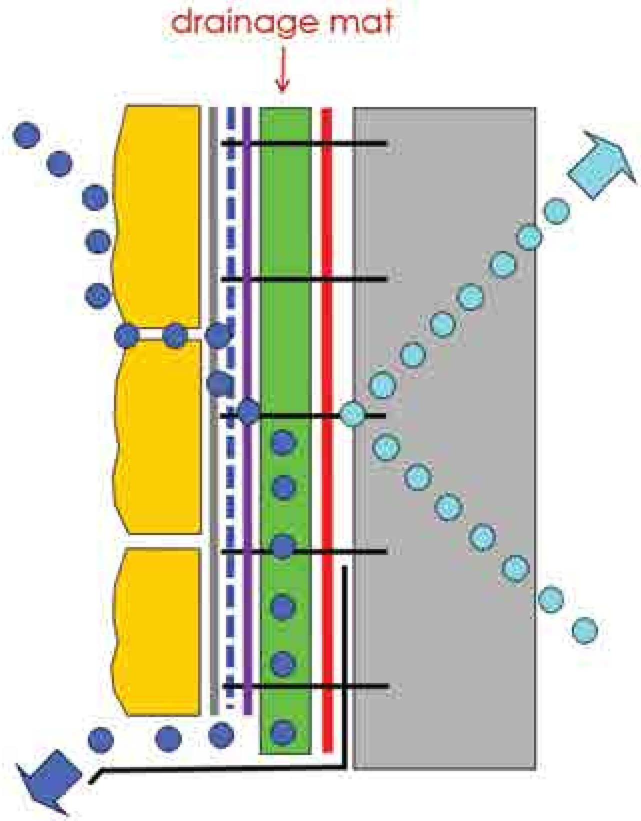
Barrier walls

There are two types of barrier walls: 'mass walls' or 'skin walls.' Design strategies employing the former with historic masonry walls generally worked well with sufficient thickness and multiple layers of masonry to absorb and release moisture to prevent it from getting to the interior surfaces. However, because of the thin profiles of adhered masonry veneers, these systems have diminutive moisture storage capacity. Therefore, mass wall design strategies with adhered masonry veneer systems are risky and only appropriate in dry climates or if a robust and tested air and moisture barrier is applied to the support wall, before the adhered cladding, and metal lath fastener penetrations are eliminated or sealed.

A 'skin wall' is a type of mass wall assembly that depends on a seal at the exterior surface of the cladding to keep moisture out—rather than having any drainage components within the assembly. Skin wall strategies are only as good as the seal; they are generally not recommended for adhered masonry veneer because the surface seal can be easily compromised by building movement, material movement, penetrations, or ultraviolet (UV) degradation that leaves the system vulnerable to moisture damage.

Many recently investigated premature adhered veneer failures have occurred with assemblies utilizing mass wall strategies—especially when the support wall comprises moisture-sensitive materials such as wood framing and wood-based sheathing. In a few recent Upper Midwest cases

Figure 3



Drainage mats stop the inward movement of moisture to protect the support wall from damage, while helping the cladding to dry out.

Figure 4

The above photo shows adhered clay brick that is cracking and debonding due to failure to accommodate vertical shrinkage of the wood structure, coupled with poor moisture control details on this four-story chimney.

involving adhered masonry veneer over wood walls, there has been:

- cracked or debonded units;
- deteriorated or swollen wood sheathing and framing members;
- deteriorated assembly components (*e.g.* corroded metal lath and fasteners);
- window damage; and
- mold.

These issues have been seen in walls as 'young' as one to six years (Figure 2, page 15). Most of these failures can be traced back to faulty design and material choices, while others can be attributed to poor workmanship.

Drainage walls

Drainage wall design strategies are the most common and effective type of adhered masonry veneer system. This approach works well in all climate zones provided there are proper water and air control layers behind the cladding. In wet climates or harsh freeze/thaw environments, it is appropriate to use a drainage wall concept with adhered masonry veneer systems that includes drainage mats or other tactics for moisture to escape the veneer system (Figure 3).

A means for drainage is a code requirement in the 2012 *IBC*. Some drainage walls can be upgraded to be ventilated, or even as rainscreen wall systems with weep vents low and high in wall panels.

Note 14 in ASTM C1780-15 states:

For optimum performance, the drainage gap shall be drained at all terminations and penetrations and ventilated at top of wall section.

Movement joints

In the early years of the adhered masonry veneer market, these thin wallcoverings were primarily used for small-scale wainscot or other exterior accents on residential building types, or for interior elements such as fireplace surrounds or feature walls. Today, the adhered masonry veneer market has expanded to include whole building elevations on multi-story commercial facilities and other large buildings with increased exposure, greater loads, complex design, and high serviceability expectations. When using adhered masonry veneer systems on large-scale projects, it is critical to accommodate material and differential movement in both horizontal and vertical directions (Figure 4).

When specified and installed correctly, adhered masonry veneer can offer eye-catching aesthetics and the desired performance.

Figure 5

The 9.5-mm (⅜-in.) gap at all sides of window and vertical movement joint in the adhered cladding is aligned with the window jamb.

Movement joints in adhered masonry veneer systems should align with any points of expected movement in the support wall, such as:

- at or near inside and outside building corners;
- at variations of mass or height in the support wall;
- where the support wall changes material or abuts structural columns or beams;
- at sheathing expansion joints;
- where the adhered masonry veneer adjoins a dissimilar wallcovering product;
- horizontally to panelize tall elevations;
- at the perimeter of window and door openings (Figure 5); and
- at penetrations.

Movement joints in adhered masonry veneers are formed by using corrosion-resistant casing beads so the joint extends at least through the mortar setting bed, scratch coat, and metal lath (Figure 6). In most scenarios, the respective aligned movement joint in the support wall is made watertight/airtight with an adhesive transition strip. If there is a flexible drainage mat as part of the detail, it can be continuous through the movement joint.

Like all cladding products, long vertical or horizontal expanses of masonry veneer should be panelized with movement joints to accommodate building and material movement. These joints should be spaced closer in walls with openings and in wall systems with less stiff support walls like wood or metal framed walls. Movement joints can be spaced further apart when applied over masonry support walls or in walls with no openings.

Figure 6

Vertical movement joint prep at interior corner (left). Cladding at interior corner, with polymer-modified scratch coat (right).

Figure 7

Properly installed metal lath and fasteners are shown at left. The 13-mm (½-in.) diameter washers at fastener heads ensure proper engagement and prevent pullout. The image on the right shows metal lath and fasteners installation. Movement joint and metal lath are properly wrapped and fastened at the corner.

In the national masonry model code, TMS 402/ACI 530/ASCE 5, Section 6.1.6.3 requires building designers to "Design and detail the veneer to accommodate differential movement." Additionally, the specifications component of the national masonry model code, TMS 602/ACI 530.1/ASCE 6, provides a "Mandatory Requirements Checklist," for designers, stating in Part 3-Execution, 3.3, D.6: "Indicate type and location of movement joints on the project drawings." In other words, it is not the mason's responsibility to locate movement joints.

Continuous insulation

With energy codes often resulting in continuous insulation requirements on the exterior side of support walls in most climates, adhered masonry veneer systems become more complex when installed more than 13 mm (½ in.) away from the support wall. In this situation, the structural engineer-of-record needs to calculate fastener type and spacing to carry the adhered masonry veneer 'system' dead load back to the support wall, and account for live loads such as wind pressures. The weight of the adhered veneer system can include:

- an extra layer of sheathing on the exterior side of the insulation;
- moisture barrier;
- drainage mat;
- metal lath;
- scratch coat;
- setting mortar;
- pointing mortar; and
- veneer units.

There are design guides to help designers calculate connection methods to transfer adhered veneer system loads back to the support wall. Fasteners used to secure metal lath to the building shall be fabricated in accordance with ASTM C1063-12C, *Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-based Plaster.* One oft-overlooked requirement of this specification is the need to have fasteners with at least a 10-mm (7/16-in.) diameter pan wafer head to ensure proper engagement with metal lath (Figure 7).

When designing adhered masonry veneer systems over continuous insulation, some of the more challenging fastener designs are when adhered veneer system loads are over insulation that is 36 mm (1 ½ in.) thick or greater and the veneer system dead load is in the range of 1.2 kPa (25 psf). In these scenarios, connections back to the support wall may need to be upgraded from closely spaced heavy-gauge fasteners to continuous metal or fiberglass Z-furring channels to carry the load (Figure 8, page 19). Of course, a structural engineer should be involved to factor in all the many variables.

When Z-furring channels are mounted perpendicular to the wall framing, it is generally considered a 'clear field anomaly' for an acceptable ci strategy as interpreted by some energy consultants. As of the writing of this article, the impact of a wide variety of building enclosures' thermal bridging continues to be evaluated in many exterior wall types and special conditions.

Figure 8

On the left is adhered veneer with rigid drainage mat and continuous insulation over concrete masonry units (CMUs). At right, continuous insulation (ci) and adhered veneer preparatory work is happening over metal studs.

Drainage mats

Drainage mats work well to prescriptively create code-compliant adhered masonry veneer systems that have the ability to drain and dry. This is especially critical when designing with absorptive cladding products over wood frame walls with wood-based sheathing.

When using drainage mats, some designers prefer to have a layer of sheathing over the drainage mat, such as exterior-rated cement board to provide a more rigid substrate for the cladding and a solid surface on which the protrusions of the self-furring metal lath sit. Self-furring lath is important, as it creates a 6-mm (¼-in.) space behind the lath so the scratch coat can properly encapsulate the metal lath for adequate bond strength and to protect the metal lath from premature corrosion.

When sheathing is not installed over drainage mats, a rigid or semi-rigid drainage mat with a fabric filter facing the scratch coat should be used to keep mortar from encroaching the drainage plane while also increasing chances for the mortar scratch coat to get behind the metal lath. Many installers have reported positive experiences with 9.5-mm (⅜-in.) thick, fluted polymer sheeting drainage mats with bonded filter fabric.

Drainage mat sheets should be installed tight to one another, with filter fabric lapped, so the mortar scratch coat cannot squeeze between the sheets and form an obstruction to the downward flow of moisture and the movement of air. To complete the drainage wall concept, a moisture and air barrier, corrosion-resistant flashing (especially above openings and at top-of-wall details), and weep screeds should be installed before the drainage mat (Figure 9).

Figure 9

Flashing and weep vents installed above a window. This wall has an adhesive water-resistive barrier (WRB), drainage mat with filter fabric, metal lath, and scratch coat.

Dry-stack veneer applications

One of the attributes of adhered masonry veneer systems is the ability to achieve a dry-stack masonry aesthetic. This installation type should be carefully

> The fact adhered masonry veneer systems differ from typical masonry cavity walls does not mean ignoring basic and proven building science concepts and required building codes of moisture management, energy control, and durability.

Figure 10

An example of unacceptable mortar-setting material coverage. At least 95 percent of the stone should be covered with mortar.

considered in wet and harsh climates with many freeze-thaw cycles. When using dry-stack cladding applications, it is crucial to create stout water and air management layers behind the cladding and use mortar additives or proprietary setting material that can resist the stresses associated with direct exposure.

When using dry-stack applications in wet climates, other tips include:

- specifying durable cladding products that can withstand exposure at unit edges;
- inspecting the installation process for complete mortar coverage on the back of veneer units so moisture cannot congregate behind the cladding (Figure 10); and
- instructing the masons to install extra setting material around the perimeter of the veneer units so mortar can squeeze out between them (Figure 11, page 21).

In all adhered masonry veneer systems, it is important to fully cover the back side of cladding units with mortar to ensure bond strength and not allow water to get trapped behind the cladding. This is especially critical when installing dry-stack adhered veneers. The new ASTM C1242-15, Section 6.7, includes a definition of acceptable full-mortar coverage on the back of cladding units. It is a good standard to use for all types of adhered veneer.

Cost, speed, and other issues

While adhered masonry veneer systems are commonly thought of as being faster and less costly to install than traditional anchored veneers, the inverse is actually the more common experience. This is particularly true on larger projects in challenging climates.

Adhered and anchored masonry veneer systems have many of the same wall components, except there are often more layers and installation steps involved with the former. For example, there may be special Z-furring channels to support thin veneers over thick rigid insulation with an additional layer of exterior sheathing and heavy-gauge or stainless steel metal lath behind the stone. There may also be a drainage mat with adhered assemblies that may be unnecessary with anchored veneer. Further, with adhered veneers, the mortar joints between stones are often installed after the veneer units—an extra step for masons not needed with anchored systems.

For these reasons, the installation of properly designed adhered veneer systems on some recently documented commercial building projects has been reported to take approximately 10 percent more time to install with about that same percentage more cost—even after factoring in the cost of a brick ledge for an anchored veneer system. Of course, there are many variables to compare for each specific project, such as overall building enclosure support wall design and foundation thickness. One of the attributes of adhered masonry veneer systems is a thinner exterior wall profile that affects other wall transition detail costs. In this regard, structural 150-mm (6-in.) concrete masonry unit (CMU) support walls offer value-added options.

Conclusion

Since adhered masonry veneer began being used in the 1950s on small-scale accents, the use of these systems has increased dramatically in the past few years, and so has their scope and complexity. While designers generally understand

Figure 11

A skilled mason applies ample polymer-modified mortar to the back of a thin stone panel for a durable dry-stack veneer installation. Split-faced CMU, dry-stack thin stone, and exterior insulation and finish systems (EIFS) combine for a loadbearing masonry retail project.

basic building science for durable and energy-efficient anchored masonry veneer systems, they are sometimes given conflicting design information or misdirection by others to skip or minimize critical control layers in exterior adhered assemblies.

To achieve properly designed and installed adhered masonry veneer systems, designers and builders must resolve building code, industry standards, and evolving manufacturer recommendations to create complete wall assemblies that can be durable in any climate. Adhered masonry veneer systems may not be faster and less costly than anchored masonry veneer, but, in many cases, they can be used quite successfully. The key is for the assemblies to be designed properly and installed by educated designers and trained masons who know better than to just do it the way they used to on small residential projects. **CS**

Notes

[1] In addition to these new ASTM standards for thin natural stone products, two helpful supplier-authored guides include Indiana Limestone Company's *Thin Veneer Installation Guide* (indianalimestonecompany.com), as well as Natural Stone Veneers International's *Installation Guide & Helpful Tips* (nsvi.com).

ADDITIONAL **INFORMATION**

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Abstract
To achieve properly designed and installed adhered masonry veneer systems, designers and builders must resolve building code, industry standards, and evolving manufacturer recommendations to create complete wall assemblies that can be durable in any climate. The key is for the assemblies to be designed properly and installed by educated designers and trained masons who know better than to just do it the way they used to on small residential projects.

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04 43 13–Stone Masonry Veneer

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B2010–Exterior Walls

Key Words
Division 04
Adhered masonry veneer
Brick
CMU
Stone

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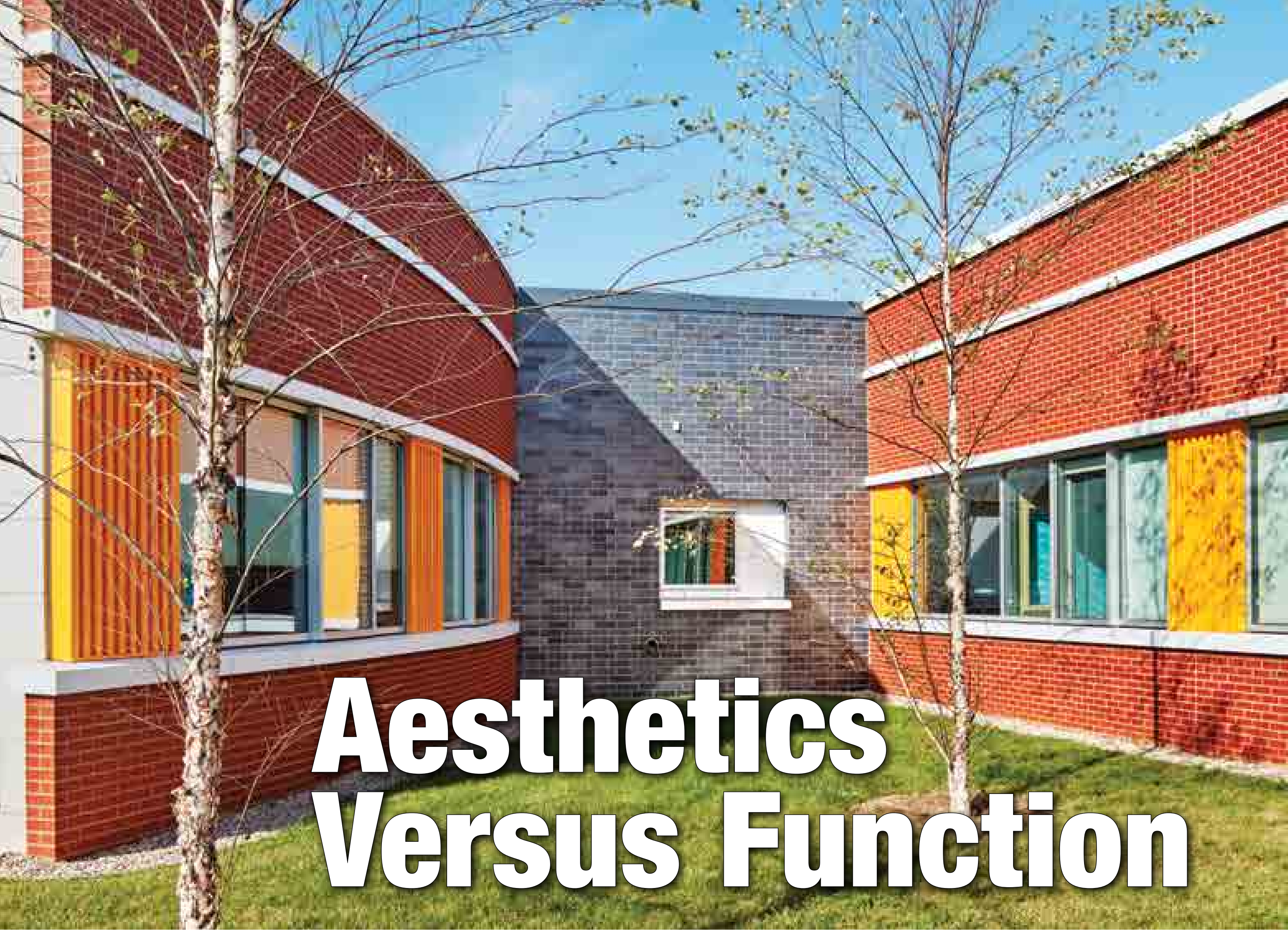
Building with Masonry Assemblies

Part Three

Aesthetics Versus Function

Resolving issues with exposed drip-edge flashing in masonry walls

BY RICHARD FILLORAMO, B.S. ARCH, A.S. CT



Aesthetics Versus Function

Resolving issues with exposed drip-edge flashing in masonry walls

Photos © Robert Benson Photography

DESIGNERS ARE CREATING NEW AND EXCITING CONTEMPORARY MASONRY DESIGNS THAT DEMAND CLEAN, SMOOTH WALL PLANE ELEVATIONS. ONE CHALLENGE THAT CAN INTERFERE WITH UNOBSTRUCTED AESTHETICS IS THE VISUAL EFFECTS OF MASONRY DRIP-EDGE FLASHING. THIS POTENTIAL OBSTACLE HAS ALSO CARRIED THROUGH TO TRADITIONAL MASONRY DESIGN. DESIGNERS AND SPECIFIERS CAN FIND IT DIFFICULT TO BALANCE DESIGN AND FUNCTIONAL WATER MANAGEMENT REQUIREMENTS.

An exposed metal drip edge diverts water and snowmelt away from the wall below, and prevents it from re-entering the wall. At relieving angles and lintels, a drip edge will direct water away from sealants joints, which can be a source of water infiltration if not maintained over time. Drip edges also:

- protect steel lintels from corrosion;
- help minimize stains on the masonry (especially below louvers);
- provide assurance that flashing has been installed; and
- prevent capillary action of moisture moving up through the masonry (also referred to as 'rising damp') when it is in contact with grade.

However, drip-edge flashing at highly visible building locations can create aesthetic concerns, as shown in Figure 1 (page 25).

New masonry flashing details, materials, and moisture control systems have enabled designers to provide water management solutions without

Figure 1

Designed by Antinozzi Associates, Theodore Roosevelt Elementary School (Bridgeport, Connecticut), also shown at left, features masonry work by members of the International Union of Bricklayers and Allied Craftworkers (BAC) Local 1-CT by Acranom Masonry, under construction manager, The Fusco Group.

sacrificing aesthetics. This article will provide details, specifications, and explanations for a variety of flashing details that can enable code-compliant water management flashing systems without aesthetic interference.

Understanding the codes

Chapter 14 of the 2012 *International Building Code* (*IBC*) provides requirements for exterior walls. Section 1403.2–Weather Protection requires exterior walls provide:

- a weather-resistant exterior envelope;
- flashing, as described in Section 1405.4;
- a design preventing water accumulation;
- a water-resistive barrier (WRB);
- a means for draining water that enters the assembly to the exterior; and
- protection against condensation.

While the code lists exceptions, the basic compliance to these provisions is still required. For example, one exception notes a weather-resistant wall envelope shall not be required over masonry walls designed in accordance with Chapter 21–Masonry. However, this does not relieve the designer from complying with the weather protection requirements, as Chapter 21 established prescriptive and engineering design of masonry and does not address weather resistance. Chapter 21 also requires compliance with *Building Code Requirements for Masonry Structures* (*i.e.* The Masonry Society [TMS] 402-11/American Concrete Institute [ACI] 530-11/American Society of Civil Engineers [ASCE] 5-11) and *Specifications for Masonry Structures* (TMS 602-11/ACI 530.1-11/

These photos are examples of exposed drip-edge flashing near grade. The top image shows a concrete masonry unit (CMU) veneer while the bottom image features a drip-edge at a shelf angle and at grade in a brick veneer.

Photos courtesy Rick Filloramo

ASCE 6-11). Chapter 6–Veneer, Section 6.16 of that first document requires the design of masonry veneers to resist water penetration.

Air, moisture, and vapor control requirements are also included in Chapter 14 and in the *International Energy Conservation Code* (*IECC*) and American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) energy codes.

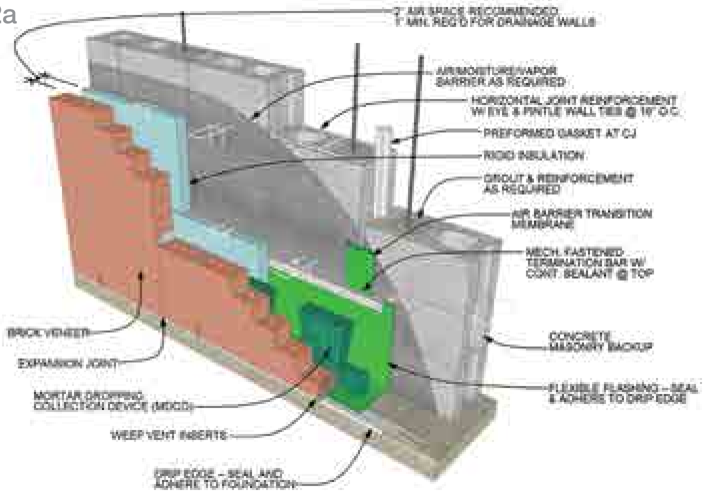
Flashing requirements

It is important to review *IBC* section 1405.4:

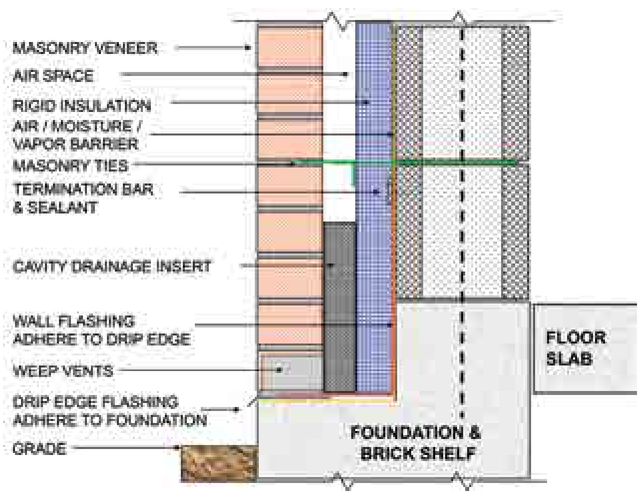
1405.4–Flashing. Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect it to the exterior. Flashing shall be installed at the perimeters of exterior door and window assemblies,

Figure 2

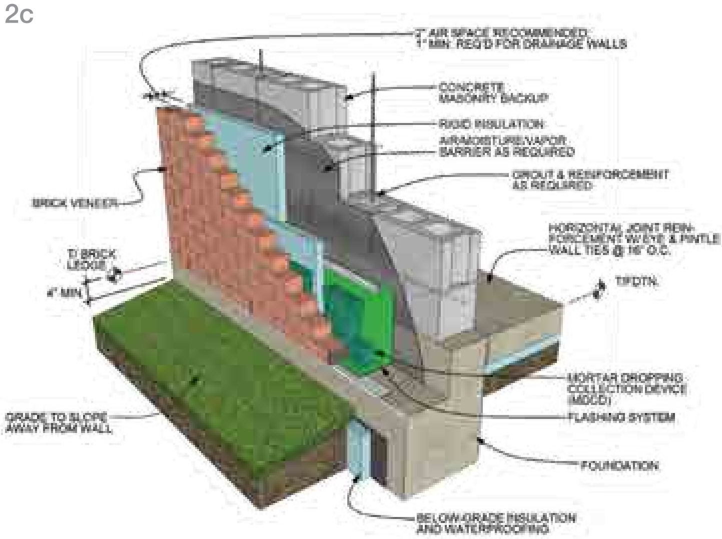
2a



2b



2c



Base of wall flashing at foundation (2a), flashing at foundation with brick shelf (2b), and 3D detail flashing at foundation with a brick shelf (2c).

Images courtesy International Masonry Institute

Figure 3

A concrete shelf above grade provides optimal protection of the masonry veneer and wall system. Landscaping can hide the concrete if desired.

Photo courtesy Rick Filloramo

penetrations, and terminations of exterior wall assemblies, exterior wall intersections with roofs, chimneys, porches, decks, balconies and similar projections, and at built-in gutters and similar locations where moisture could enter the wall. Flashing with projecting flanges shall be installed on both sides and the ends of copings, under sills, and continuously above projecting trim.

1405.4.1–Exterior wall pockets. In exterior walls of buildings or structures, wall pockets or crevices in which moisture can accumulate shall be avoided or protected with caps or drips, or other approved means shall be provided to prevent water damage.

1405.4.2–Masonry. Flashing and weep holes in anchored veneer shall be located in the first course of masonry above finished ground level above the foundation wall or slab, and other points of support, including structural floors, shelf angles, and lintels where anchored veneers are designed in accordance with Section 1405.6.

Exposed flashing is generally metal, and installed to prevent moisture from entering the wall are predominantly found at roof/wall interfaces or at other locations adjacent to another exterior façade material or element. Flashings are installed to re-direct water to the exterior and are attached to the vertical masonry backup, preferably along with a termination bar and sealant (Figure 2). The flashing is then installed along the horizontal plane where water exits through weep vents.

The next code requirement—flashing at perimeters of exterior openings or locations where water could enter the wall—is sometimes misinterpreted or confused with air/moisture/vapor barrier requirements. Generally, through-wall flashing is installed at vertical windows and doors (perimeter jambs), as these locations are not typically considered spots where water can enter and flashing can be detailed and connected to effectively drain water. However, window and door jambs, and other similar openings, often require a moisture management transition membrane integral with the air/moisture/vapor barrier.

There is only one location in the code where a 'drip' is code-required, as defined in 1405.4:

Flashing with projecting flanges shall be installed on both sides of and the ends of ends of copings, under sills, and continuously at projecting trim.

This definition applies to metal exposed copings and exposed flashings over wood or other exterior trim elements.

In 1405.4, the 2012 *IBC Code Commentary* notes exposed flashing drips prevent the re-entry of moisture below the flashing. Figure 1405.4(5) illustrates this concept, but the details do not indicate the industry requirement that flashing be sealed to the surface below. This assists at preventing moisture from reentering the wall system and flashings that extend to the face of masonry have performed successfully for years. The code and commentary also indicate other acceptable practices.

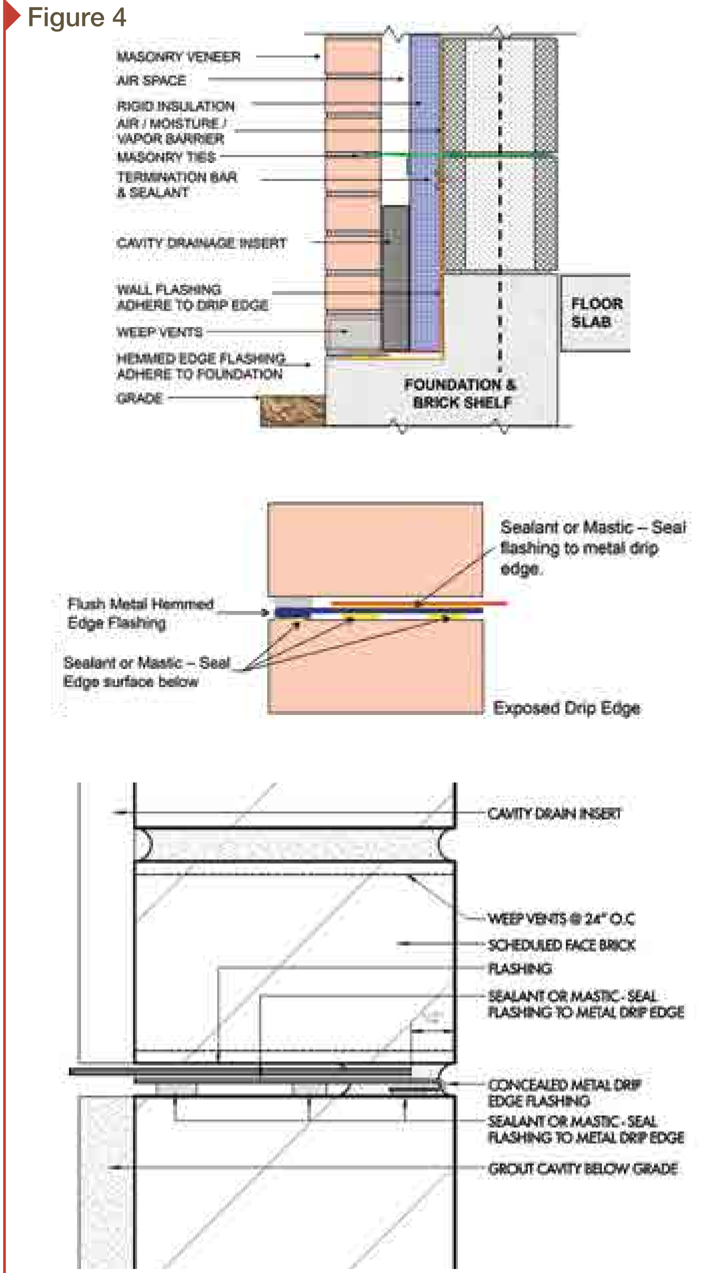
Base of wall: Masonry above grade

Flashing at the base of walls, near grade and with exposed flashing drip edges, are highly visible and noticeable, especially at building entrances, exterior patios, sloping grades, and at prominent elevations. Normal tolerance in the concrete shelf and foundation can further cause aesthetic detraction by creating inconsistent drip-edge overhangs.

Figure 2 illustrates a typical wall section in which the exterior masonry veneer begins 100 to 150 mm (4 to 6 in.) above grade on the foundation or brick shelf (as shown in 2b and 2c). These details offer the most protection for the masonry veneer as it is not in contact with soils or landscaped material, and is less susceptible to staining (*i.e.* the aforementioned 'rising damp').

Masonry materials that are elevated, as shown in these details and illustrated in Figure 3 (page 26), are also protected from snow removal and general maintenance at walks, paved areas, and lawn and landscaped areas.

Figure 4



Flush hemmed-edge flashing does not interfere with exterior aesthetics, as this concrete masonry unit (CMU) veneer example demonstrates.

Images courtesy IMI and Antinozzi Associates

While Figure 2 shows a typical exposed metal drip edge, flush hemmed-edge metal flashing (which terminates at the exterior face of the veneer) has recently been used to eliminate the aesthetic exposure of the drip edge (Figure 4).

The critical requirements for using hemmed-edge flashing are:

1. The metal flashing must have a hemmed edge—approximately 12 to 20 mm (½ to ¾ in.) to provide rigidity of the metal flashing and protect the installers and public from sharp edges.

Figure 5

Successful results with flush hemmed-edge flashing at Theodore Roosevelt.

Photos courtesy Rick Filloramo

Figure 6

New stainless steel membrane adhesive flashings can be cut after they have been installed to follow the contour of the stone veneers.

Photo courtesy Centerbrook Architects

2. The hemmed-edge flashing must be sealed and adhered to concrete or the surface below to prevent water from entering under the flashing system. This detail is made possible and durable thanks to new butyl and hybrid butyl-silicones that remain flexible, are less likely to dry out over time, and do not 'drool.'
3. The hemmed edge must be flush with the exterior face of the veneer.
4. The continuation wall flashing (either membrane or metal if two-piece) must be sealed and adhered to the top of metal flashing with two or three beads of sealant as shown in Figure 4. This is critical, even with drip flashing, to prevent water from migrating under the flashing.
5. A brick shelf 100 to 200 mm (4 to 8 in.) lower than the top of foundation and floor slab is recommended, but not required. This acts as redundancy protection—should water enter the system, it will not enter the building at the floor level.
6. Installing the horizontal flashing leg, drip edge, or flush edge at a slight bevel to the exterior assists in directing moisture to the outside of the wall assembly. This is accomplished by mortar wash or other acceptable methods. Sloping the flashing may not be necessary if the horizontal leg is secured and adhered to the surface below to prevent water re-entry. The designer has options based on each type of detail.

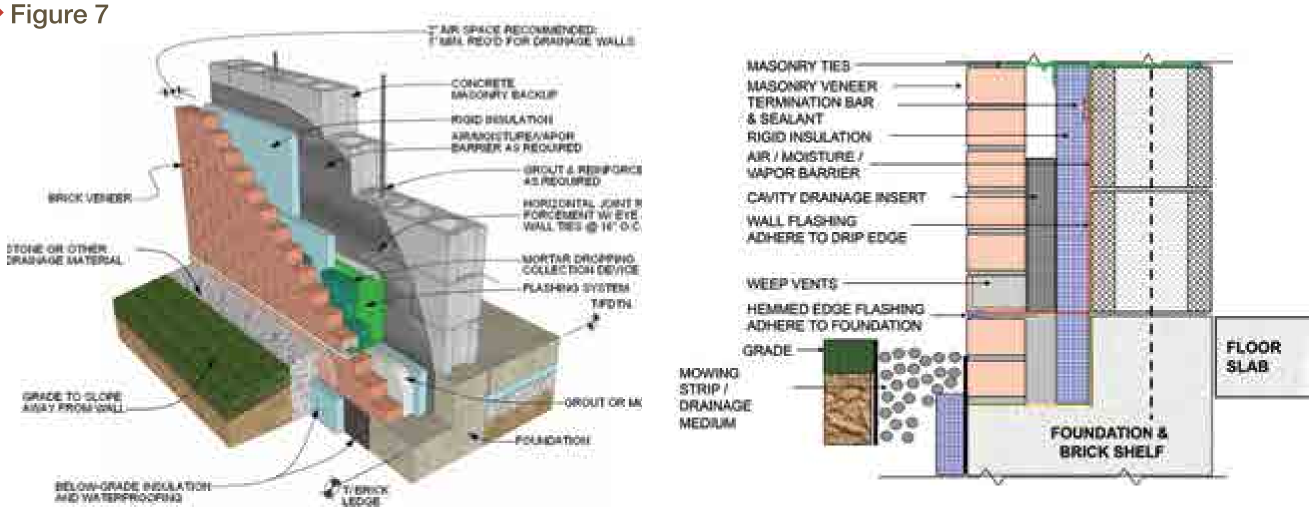
Figure 5 depicts successful results with flush, hemmed-edge flashing.

Stainless steel membrane flashings consisting of a thin layer of stainless steel bonded to an adhesive layer are fairly new to the market. They can be cut after installation to follow the contour of the veneer, which is especially useful with split-face stone products (Figure 6). The aesthetics of this detail and care of installation should be agreed on with a mockup panel.

Base of wall: Masonry below grade

Many designers prefer the masonry to start below grade to achieve a more uniform appearance and offer continuity in the elevation. This is especially true at elevations where the grade changes or slopes and can leave uneven areas of exposed concrete foundations. While this detail provides more challenges, a base-of-wall flashing system

Figure 7



Masonry below grade with exposed drip-edge (left) and hemmed-edge flashing (right).

Images courtesy IMI

Figure 8

Installations with various drainage strips and landscaping stones.

Photos courtesy Rick Filloramo

can still be achieved with or without an exposed metal flashing drip edge. Figure 7 illustrates this detail with exposed drip-edge flashing and a flush hemmed edge. In either scenario, it is critical to include a 300 to 400-mm (12 to 16-in.) wide mowing strip or drainage bed filled with landscape stone to allow moisture to drain away from the masonry veneer. Figure 8 shows installations with various landscape stones.

The water should be directed to the exterior wall drainage system below grade. When a drip edge is used, there is protection from staining migrating up the wall. It is important to consider the density and durability of any material used below grade. Some bricks that are hard, dense, low-absorptive, and have a smooth face are more durable and suitable than a soft, highly absorptive or textured brick in this application. Some designers often use a base of hard dense stone, which also provides an accent relief band.

Figure 9 (page 30) is an example of a successful installation with a mowing strip and flashing cut flush with the wall. This installation, which has endured well, is more than 30 years old. Figure 10 (page 30) is an installation with no mowing strip and perhaps a more absorptive brick. Other issues may be a lack of maintenance and irrigation spray hitting the wall. Moisture stains and moss have infiltrated the wall.

Top of walls

Another aesthetic concern has escalated with the advent of contemporary design—the transition detail at the top of walls at masonry copings. This is true at site walls and tops of buildings at roofs and parapets. The traditional detail with a

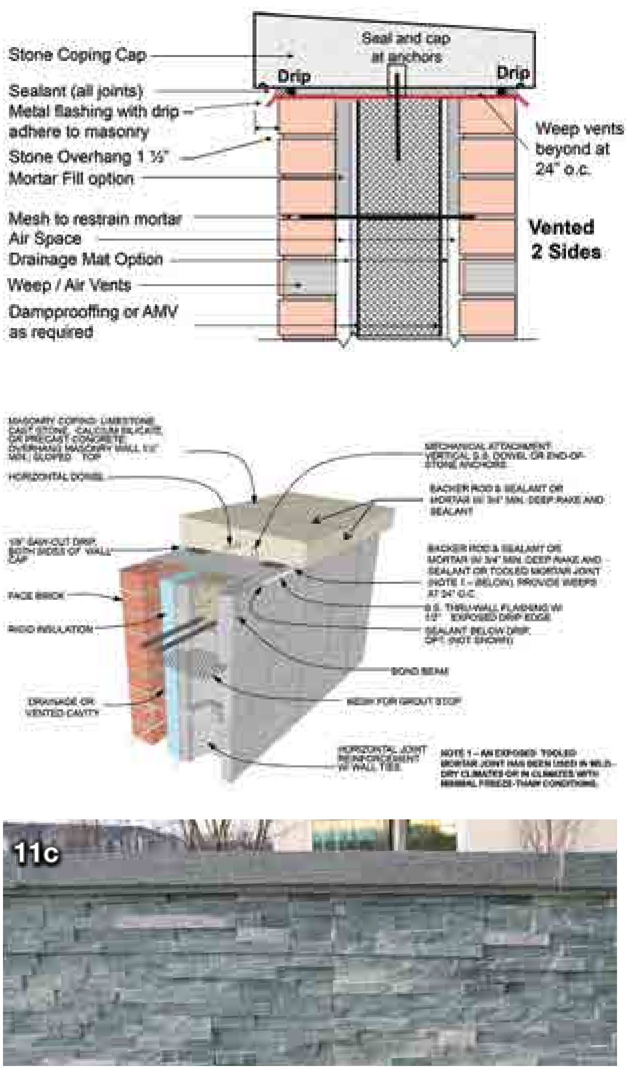
Figure 9

In the photo above, mowing strip and drainage material protect the brick. High-strength, dense masonry units provide superior protection below grade in this case.

Figure 10

Brick staining near grade. Possible culprits include no mowing strip or drainage material, lack of drip edge, softer (and more absorptive) brick improperly maintained, and irrigation hitting the building.

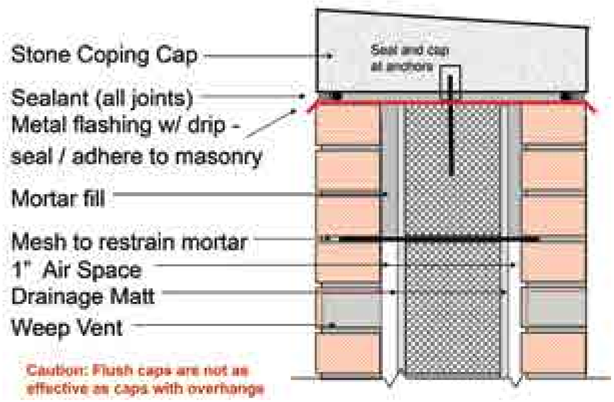
Figure 11



Top of wall: detail of a stone cap with overhang.

Images coutesy IMI

Figure 12



Top of wall: flush cap with drip-edge flashing.

coping stone or precast coping has the components shown in Figure 11.

1. The coping will overhang the top of wall 40 mm (1 ½ in.) and include a drip cut in the underside of the stone.
2. Metal flashing with a drip edge is securely installed under the stone coping.

Designers that desire a clean, smooth elevation are eliminating the stone overhang. This is acceptable as long as a drip-edge flashing is utilized, as shown in Figure 12. Some designers have gone a step further and eliminated the drip-edge flashing to use the flush hemmed-edge flashing only (Figure 13, page 31).

While this detail has been used, it is critical the hemmed-edge flashing extend to the face of the masonry and be sealed and adhered to the masonry below. This can sometimes be challenging when accounting for normal tolerances in construction and materials. It should be noted these details with flush caps are not as effective at deterring water as caps with overhangs and drip-edge flashing.

Other locations

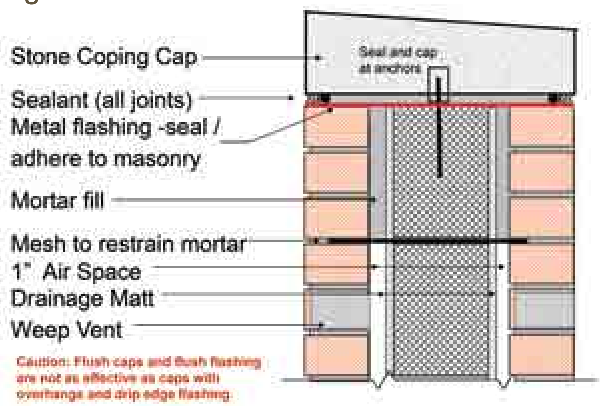
Flush hemmed-edge flashing has been used at other locations such as lintels and shelf angles, but does not provide as much protection as its traditional exposed drip-edge counterpart. Drip-edge flashing at lintels above windows, curtain walls, and other openings assists at diverting water away from the sealant joint between the window and steel lintel above (Figure 14).

Conclusion

With proper care in detailing and installation, flush-hemmed-edge metal flashing can successfully provide moisture management and not interfere with building aesthetics. It must be sealed and adhered to the surface below to prevent water from entering under the flashing system, and extending to the exterior face of the masonry veneer. Drainage or mowing strips should be used at all locations where masonry is below grade.

Exposed metal-drip-edge flashing provides superior protection at lintels and shelf angles where long-term protection of the adjacent sealant joint will reduce the possibility of water infiltration. In all applications, it is critical to detail and specify materials correctly and accurately and provide quality assurance (QA) language that provides solely for trained installers. **CS**

Figure 13



Detail of flush cap with hemmed-edge flashing.

Figure 14

Drip-edge flashing above a door protects the steel lintel and diverts water away from the sealant joint at the doorframe.

ADDITIONAL **INFORMATION**

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Abstract

Exposed metal-drip-edge flashing diverts water and snowmelt away from the wall masonry below, and prevents it from re-entering the wall. At relieving angles and lintels, a drip edge will direct water away from sealants joints, which can be a source of water infiltration if not maintained over time. These products also protect steel lintels from corrosion, minimize masonry staining, and defend against rising damp. However, drip-edge flashing at highly visible building locations can create aesthetic concerns. What is a designer to do?

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04 05 23–Masonry Accessories
04 20 00–Unit Masonry
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Key Words

Divisions 04, 07
Drip-edge
Flashing
Masonry
Moisture

Building with Masonry Assemblies

Part Four

Restoring Freedom

A masonry building's rebirth, brick by brick

BY JASON HOLTMAN

Restoring Freedom

A masonry building's rebirth, brick by brick

All images courtesy Western Specialty Contractors

SINCE OCTOBER 2014, ST. LOUIS' FREEDOM PLACE (4011 DELMAR BLVD.) HAS SERVED AS A SYMBOL OF HOPE FOR THOSE WHO ARE LESS FORTUNATE. CONSTRUCTED IN 1928, THE RESTORED APARTMENT BUILDING UNDERWENT MAJOR CHANGES BY THE ST. LOUIS MASONRY BRANCH OF WESTERN SPECIALTY CONTRACTORS, IN ORDER TO TRASFORM IT BACK TO ITS ORIGINAL GLORY.

Located three blocks from the John Cochran VA Medical Center, it represents Vecino Group's first St. Louis project; the developer's primary focus has been historic rehabilitations and affordable housing in southwestern Missouri. Recognizing the building's potential, Vecino Group formed a partnership with the St. Patrick Center and the Department of Mental Health. It invested $12.7 million to renovate the five-story structure into supportive housing for veterans who, according to city officials, make up about 12 percent of the city's homeless population.

The 68-furnished unit apartment building now provides onsite support, rental assistance, weekly support meetings, a gym, a children's playroom, meeting rooms, and living areas. In 2015, Vecino Group was selected for a Preserve Missouri Award in recognition of the project.

Western Specialty Contractors was contracted in late 2013 by general contractor Horace B. Deal Construction Inc. (HBD), to perform a complete façade restoration of the 3716-m^2 (40,000-sf) structure. Abandoned for over a decade, a large portion of the building's brick, terra cotta, and concrete foundation was ruined.

The scope of the work involved restoring the crumbling interior masonry walls. Broken windows throughout the building and missing copper downspouts had exposed the walls to the elements, causing major damage and

Before tuck-pointing could begin on the brick, crews had to examine existing building joints, which were frequently different due to the building's multiple repairs over the years.

instability. An initial survey of the interior revealed multiple failing walls—the result of deterioration in the clay tile backups.

Each damaged wall was field-measured, and the developer was provided a detailed schematic showing each rebuild area with brick and block needed to be installed. Twenty-four interior masonry walls were repaired throughout the building, and the backups were replaced with standard concrete masonry units (CMUs).

Broken floors, which were unstable to walk or set materials on, provided a challenge on the project. The façade restoration crews managed to work around the demo team while it made floor repairs; they were required to stage equipment and load their CMUs in specified areas while the floor was being stabilized.

Since the project was located within the St. Louis City limits, Western was required to subcontract with woman and minority business enterprises (MBEs/WBEs) to participate on the project. An MBE masonry firm was hired to complete some of the brick and block infills at grade, along with a few of the full wall rebuilds.

Restoring the masonry/concrete façade

After the interior masonry work was complete, the next step was restoring the building's masonry and concrete façade. A complete visual inspection and sounding of each masonry wall was completed to determine which bricks needed to be replaced. Thus, approximately 3000 broken and missing bricks on the building's façade were restored with new or salvaged bricks from a local supplier that closely matched the originals.

Before tuckpointing could begin on the brick, existing building joints had to be examined. Different types of joints had been used during the building's lifespan due to the need for multiple repairs. Therefore, it was difficult for the team to determine which joint profile had been used when the structure was originally built. A concave profile for the tuck-pointing provided the best design for shedding water away from the masonry walls.

Mockup samples were created to give the general contractor and historical consultant a visual reference for selecting a mortar color and seeing how the joint profile would look. This process also helped give an idea of where in the building the mortar mockups should take place. Different colors were applied and reviewed in different lighting.

The bulk of the masonry work was done during the winter. A proprietary accelerating, water-reducing admixture (WRA) for concrete that did not contain calcium chloride or added chloride ions was added to the mortar to accelerate its set time in cold weather. This technique allowed workers to install the CMU backup walls during the winter, keeping the project moving on schedule. Additional work on the structure's exterior included restoring the top chimney bricks and installing a new mortar cap with a positive slope.

A silicone elastomeric coating was applied to 20 cornice units to waterproof and cover spider cracks. Repairing fire damage to its existing skim coat was accomplished by sounding the wall first, then removing any damage using a chipping hammer. The exposed rebar was coated with a standard anti-corrosion coating; then a fiber-reinforced, quick-set patch material was applied, followed by a coating of a special type of concrete repair mortar.

The onsite crew used suspended scaffolding, aerial lifts, and traditional scaffolding to access the various areas of the building's façade.

Built in 1928, St. Louis' Freedom Place recently underwent an ambitious restoration to create housing and opportunities for veterans.

A thorough cleaning

The concrete/masonry restoration was completed by thoroughly cleaning all the brick, terra cotta and concrete on the building's exterior. Specifications called for using a non-aggressive detergent including bleach and trisodium phosphate (TSP)—a formulation employed in order to kill mildew and remove its characteristic stains. The detergent was brush-applied to a wet wall, and then power-washed.

Crews used a heavy-duty, fast-acting restoration cleaner and high-pressure water to remove graffiti from the exterior of the facility. The bricks' matte finish made total graffiti removal difficult—thus, numerous applications of the restoration cleaner was used to get the job done. Afterward, a water-based silane/siloxane water repellent was applied to the building's façade using sprayers.

Restoring the terra cotta storefronts

The final stage of the project involved the restoring of the building's original terra cotta storefront pieces. More than 140 damaged pieces were removed and replaced with glass-fiber-reinforced concrete (GFRC) replicas. Full replacement pieces were made from the mold from an existing 'good' or sound piece of terra cotta and others were repaired by using a patching compound, followed by a silicone elastomeric protective coating.

Craftsmanship was the key to restoring the terra cotta storefront. The first step in the process was removing loose or delaminated pieces; pins were added to the original piece to provide additional areas for adhesion, and lifts of repair material were then installed until the restoration was flushed with the original surface. If the piece was split in half, an epoxy was used in order to 'glue' them back together, followed by a patching compound.

When the replicas were being made, many of the original terra cotta pieces were discovered to not be identical in dimensions. This unexpected development caused crews to remove several sound terra cotta pieces from the walls than originally anticipated to create more molds of varying sizes to create the replicas.

Similarly to the method used to create mockups for the custom brick mortar colors, the team created mockups of the terra cotta pieces, displaying a variety of grout color shades for the general contractor and historical consultant to review.

When painting the terra cotta replicas to match the existing, aged pieces, old-fashioned trial and error was used to get the right color combination. They applied various paint colors to the pieces using sponges and brushes of various sizes and even smeared the paint with a cloth to replicate the aged appearance. After viewing the mockups from the recommended 9 m (30 ft) away, the general contractor, architect, and historical consultant approved a mockup color for all of the terra cotta replicas, following several rejected color combinations.

The work included restoring crumbling interior masonry walls. Broken windows throughout the building and missing copper downspouts had exposed the walls to the elements, causing major damage and instability.

Conclusion

The Freedom Place façade restoration project faced many challenges—from winter weather to extensive vandalism, missing or damaged original materials, unsound floors, and multiple mortar joints to decades of weather damage. Fortunately, the use of modern restoration technology and craftsmanship prevailed on the jobsite.

By knowing which product effectively removes graffiti from matte bricks, which tuck-pointing profile provides the best waterproofing, which product best covers spider cracks, and what to mix with mortar to accelerate its set time during cold temperatures, Western's crew was able to successfully resolve its challenges and keep the restoration project on schedule. **CS**

After completing the interior masonry work, the façade was the next step. A complete visual inspection and sounding of each wall was completed to determine which bricks on the building's façade needed replacement.

ADDITIONAL **INFORMATION**

Author

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Abstract

Transforming the façade of a dilapidated St. Louis building to help create housing for homeless veterans involved various challenges, from winter weather to extensive vandalism, and from missing original materials to unsound mortar joints. By knowing which product effectively removes graffiti from matte bricks, which tuck-pointing profile provides the best waterproofing, which product best covers spider cracks, and what to mix with mortar to keep it from freezing, the specialty contractors were able to successfully resolve these problems and keep the restoration project on schedule.

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