



1440 Renaissance Drive #340,
Park Ridge, IL 60068
www.masonryadvisorycouncil.org

MOISTURE CONTROL

Masonry Flashing for Exterior Openings

Moisture entering buildings has the potential to cause problems for the health and well-being of the building inhabitants if the building envelope is not designed and constructed properly. Thus, the flashing of masonry for exterior openings is tremendously important to architects, engineers, and contractors.

Exterior doors and windows are gaps in the wall where the moisture drainage cavities are terminated. Water moves through exterior wall elements based on the porosity, a measurement of the small holes that allow air or liquid to pass through objects. When air enters the building it is seen as leakage, and when moisture enters the building it is permeable. Parapets, openings, masonry units, and foundation bases could allow moisture to get inside the wall.

Constant moisture alone can be accommodated; however, trapped moisture has a chance to freeze and thaw on the inside of the wall causing damage to occur, as well as efflorescence. Flashing of parapets and openings are the primary defenses of a wall system to channel the exit of the moisture.

Openings in the wall for windows and doors require structural designs to transmit the load to the edges of the opening with lintels or arches. The weight of wall above the opening can be carried across the span by steel, concrete or masonry. Different lintel materials and shapes affect the flashing for the moisture control of the opening. Lintels are designed based on many factors including the span, load, and whether arching action occurs in the masonry above the opening.

There are three different types of flashing that can be used to prevent moisture penetration: metal, composite, and plastic (elastomer). Designing flashing for the duration of the structure plays a key role in determining the type of flashing to use. Steel and copper are the metal alternatives which provide the best durability/longevity in the wall. These are the most expensive choices, and are great for buildings with over 100 year design life like many publically funded projects. Note that copper flashing can stain the bricks over time as the metal oxidizes reacting with the atmosphere.

Due to the discoloration to the masonry exterior from copper flashing, composite materials have been created to laminate to the copper. The adhesive bond between the metal, and plastic film may shrink or separate over time. Aluminum metal with a laminate is very workable, and can be cut with scissors. Plastic (elastomeric) flashings like polyvinyl chloride (PVC), Ethylene Propylene Diene Monomer (EPDM), and Thermoplastic Polyolefin (TPO) are synthetically manufactured. They have trouble when installed in lower temperatures, especially PVC. They are easy to fix when torn, or otherwise damaged, and can stick to themselves to allow easy overlaps for installation if bought in the peel n' stick form.

End dams are one of the most important parts of the flashing system. They prevent lateral movement of moisture, and protect the sides of an opening from water penetration. Joe Pullara, Technical Reviewer of FGM Architects, prefers to "place end dams at the edge of the lintel, past the openings."

This is good practice, but hard to show in a two dimensional drawing. Typically a wall cross-section would be used to display the design on the lintel including the moisture control with flashing. This view makes it very difficult to identify end dams, and if they are not shown on the drawing, may not be installed in the wall construction.

Take a look at figure 1, of a window lintel with the end dam shown over the flashing for clarity, although in reality the end dam is placed first. Pat Conway, AIA, of the International Masonry Institute (IMI) adds “some end dams do not have adhesive backing, and if placed after the flashing can allow moisture to move under the end dam laterally”. To prevent installation error it is good practice to detail end dam installation first.

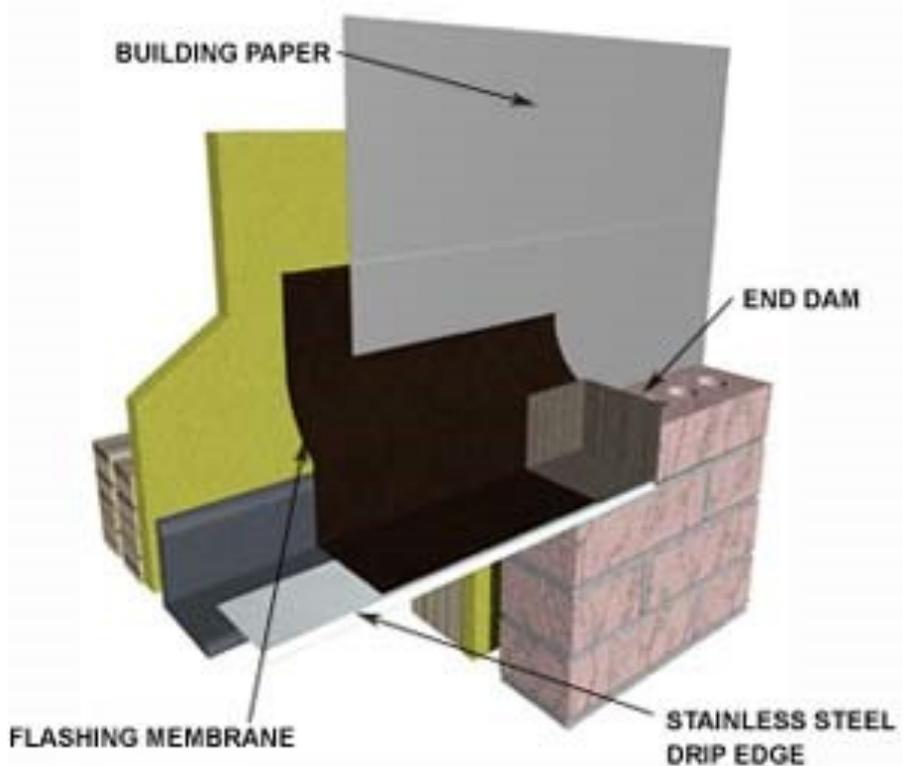


Figure 1: Load bearing lintel detail with end dam shown over the flashing for clarity

Dale Kent’s experience comes from masonry restoration, and he now works with Facilities Engineering, Inc.

“The wall I prefer to deal with is triple wythes of brick with arches on the openings,” said Kent. “The arch’s slope acts to direct the moisture away from the opening. Flat steel angles or I-beams allow places for moisture to pool above the opening causing problems for the lintel. We typically will go in to repair that area, and often weld a plate at the crux of the steel shape. Then we will weld a new plate at an angle to pitch the moisture towards the weep vents.”

Due to cost constraints it is uncommon to see three wythes of masonry in new construction, and likewise pitching the steel towards the exterior of the building requires specialty shapes that increase the cost. Knowledge of moisture movement is essential to funneling moisture out of an exterior wall.

Water requires a 2% grade, or 1" in elevation for every 4ft of distance to move off a surface. Arches provide a natural method for moving moisture away from the opening. Curved arches require less maintenance over time versus steel lintels with flat bases.

The main escape point for moisture from the wall is through weep vents. The Masonry Advisory Council (MAC), as well as the IMI, and Brick Industry Association (BIA) recommend using weep vents. Tubes and ropes are not recommended for adequately transmitting moisture out of a wall. Cell vents are typically placed at the head joint of exterior brick and have small holes to allow moisture to escape while preventing bugs, and other debris from entering the head joint.

Weep vents are great for removing water that is in the immediate vicinity of weep vent, which MAC recommends being placed at 24" on center (tighter than the code required minimum), however, as discussed earlier moisture will not move without having a pitch of 2% grade. This means that moisture in between weep vents will have trouble escaping if the moisture level is low.

Immediately following rain events there would be enough moisture to provide the hydraulic head to push the water out of the weep vents through gravity, but as the height of water in the wall lowers the amount of hydraulic head (hydrostatic force) diminishes. Without pitching of the steel towards the weeps, or towards the exterior of the building small amounts of water will still remain in the wall pooled on the flashing.

During the construction process mortar tends to fall into the cavity when masonry units are laid, and the probability of mortar in the cavity increases greatly above two stories of height.

Colin Munro, the first Executive Director of the Illinois Masonry Institute now known as the Masonry Advisory Council says "it is good to run the flashing up the wall higher than the mortar net".

Running the flashing up the inside face of the cavity wall prevents any pooling moisture on the mortar droppings to enter the back-up wall, and eventually the building interior. Refer to Figure 2 for more clarity on the interaction between flashing level, and the height of the Mortar Net in the cavity.

Mortar can also cause problems with moisture control where mortar fins protrude into the cavity, and can create a terminus in the cavity allowing moisture to pool. A necessary element of a wall that manages moisture is the air space which allows the moisture to move in the wall to the drainage area above the openings. The minimum required air space in the Masonry Standard Joint Committee (MSJC) Code is 1", however 2" is a good recommendation to provide air flow, and moisture drainage.

According to Kent "stainless steel creates a bond break at the sill, and with the fleece side up provides a continuous drainage plane. There also is no galvanic action between stainless steel, and copper drip edges." Receding the copper flashing into the wall will prevent the copper oxidation from staining the brick visibly when used with a stainless steel drip edge.

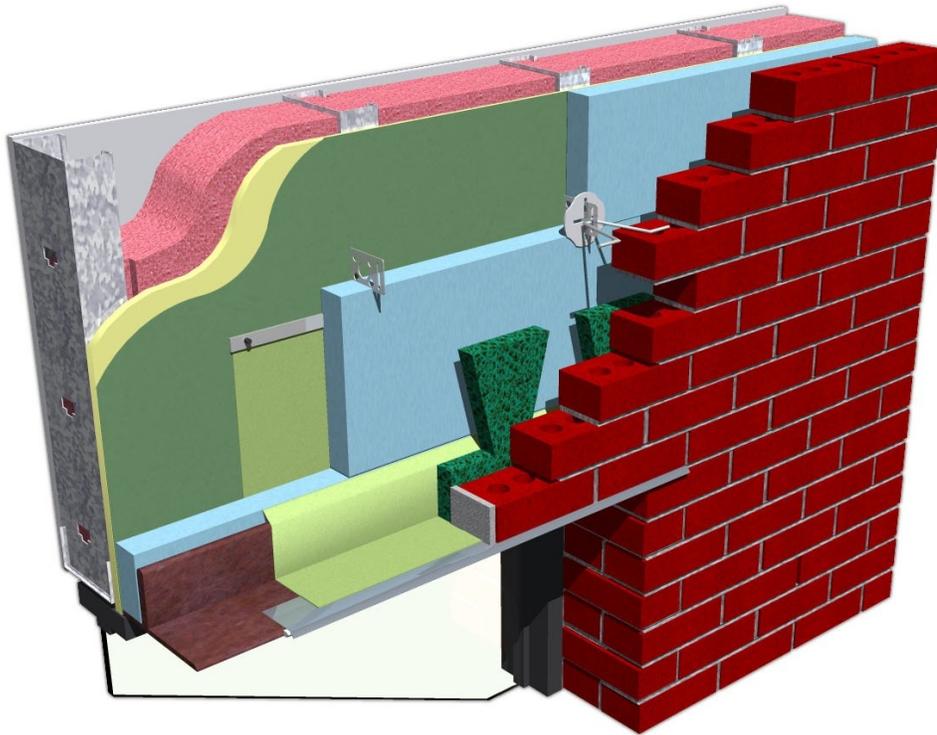


Figure 2: Properly detailed lintel with steel stud back up, and brick veneer

A good detailing, and installation technique is to apply the drip edge with caulking first, and then to apply the flashing over the drip edge receded 1" from the face of the facade.

Architects in general send their preliminary plans to engineers with the lintel material, shape, and location drawn in for the Structural Engineer to design.

According to Barry Pecho, P.E., S.E., the Senior Structural Engineer at Smith LaSalle engineering firm, says collaboration is important.

"A designer will try and design the lintel to fit the shape that the architect has defined, and the most productive design for masons in the field," Pecho said. "It is not uncommon to size beams based on the coursing of the masonry, or to try and replace a course of masonry in the wall with the lintel."

The structural engineer and the architect while collaborating to refine the design should discuss the deflection of the lintel in regards to moisture control.

Longer spans, and spans with heavier load cause more deflection of the lintel. L-angles typically deflect more than I-beams. Over the lifespan of the lintel the steel will deflect. This deflection adds pitch to the beam towards the center that can be used to channel water.

"It is advisable to add two weeps closer together in the middle of a steel lintel where the water pools," Pecho added. Arches also move the moisture to the edges. The water will run down the arch until the point where the thrust will be applied to the wall, the crux at the base of the arch. Target this area with an end dam, and place a weep there to channel out the built up moisture.

Engineers seeking to design more masonry arched openings should look towards BIA Tek note 31A, and "The Masonry Arch" by Jacques Heyman. Lastly the IMI has a technical brief on the flashing of arches, Tech Brief 2.7.5 Flashing Installation: Special Conditions steeped Foundations, Arches, and Pitched Roofs.