



MASONRY PARAPETS in FREQUENT FREEZE/THAW CLIMATES

By Robert W. Humbarger, RRC, CDT

"Parapet walls can be particularly troublesome. With two exposed surfaces, parapets are subjected to extremes of moisture and temperature that may be substantially different from those in the wall below."¹

In mid-northern climates with frequent freeze/thaw cycles, there are three general rules to keep in mind when specifying and maintaining exposed masonry parapet walls:

1. Treat every horizontal surface as a roof and every vertical surface as a wall.
2. Moisture migration and vapor drive must be controlled.
3. Masonry surfaces must be allowed to breathe.

There are a few exceptions, but each exception must have a provision to deal with the destructive forces of nature.

Water is a unique compound that expands when it changes from a liquid to a solid. Consequently, we should learn to deal with the phenomenon by controlling the conditions that cause problems in our buildings.

In mid-northern latitudes, where temperatures often fluctuate above and below the freezing point on a daily basis throughout each winter, exposed porous surfaces must be able to withstand the repetitive freezing/thawing cycles. Each time the pressure from the formation of ice crystals exceeds the bond of adjacent materials (inside or adjacent to each masonry unit) to the extent that it creates or widens some of the minute openings, it allows more water molecules into that void during subsequent wetting cycles. Then, in future freeze cycles, it creates even more pressure and widens the openings farther.

This process is much slower in the far north, which only undergoes a few freeze/thaw cycles each spring and fall. There are, however, a number of related factors that influence areas with excessive freeze/thaw cycles other than just latitude (such as weather patterns, geographical proximity, elevation, and orientation). This article focuses primarily on these high frequency freeze/thaw cycle areas, regardless of where they are. The determining factor of where these recommendations apply is the frequency of the freeze/thaw cycles.

General Considerations

Masonry and concrete are two building materials that require special consideration to withstand the accumulating effects of repeated freeze/thaw cycle pressures. Exposed concrete with horizontal surfaces needs air entrainment admixtures in the mix design to resist surface spalling. High porosity brick should be

avoided. All brick used in these areas should be ASTM C216 - Grade SW.² Mortar must be softer than the brick to prevent spalling of the brick. Mortar used for re-pointing and tuckpointing must be softer (and therefore more porous) than the original mortar.

Treat Horizontal Surface As a Roof

The exposed horizontal surfaces of vertical mortar joints (between parapet coping units) should be avoided, where possible, in climates with frequent freeze/thaw cycles. Rowlock brick (brick laid with the face side up in a nearly horizontal position such as on the top of a garden wall or on window sills) should be avoided altogether if possible. Longer masonry units used for parapet copings, such as cut limestone, have fewer vertical mortar joints between the units. This reduces the number of areas to be maintained, but the exposed horizontal surface of these vertical mortar joints is subject to similar deterioration from freeze/thaw cycles. Since there are fewer joints, each is subject to more expansion and contraction force. (After new construction, concrete unit masonry shrinks and brick masonry expands.)

The deterioration of mortar in exposed parapet coping joints is a slow but inevitable process throughout each winter. Water-repellent applications with high concentrations of silanes or siloxanes (see below) slow the deterioration process but are not long-term solutions.

One might suggest that limestone parapet caps should be avoided in northern climates with frequent freeze/thaw cycles, but that would seriously lessen the aesthetic value of certain structures and would be trading a product that lasts thousands of years for one with a life-cycle of perhaps a half century or less. Instead, to minimize the maintenance of joints between units, this author recommends treating every horizontal surface as a roof and every vertical surface as a wall.

To do this, use properly-sized³ sealant joints (with backer rod or bond breaker tape below the sealant) on the horizontal part of all masonry coping joints. The sealant can be extended down the side (vertical edge) of the joint when the cap is 4" or less (exception to the "vertical surface as a wall" rule). On parapet copings more than 4" thick, it is recommended to first re-point the vertical portion of deteriorated side joints with mortar up to an elevation just short of what will be the bottom of the horizontal backer rod or bond breaker tape elevation needed to form the proper width/depth ratio of the sealant. The top horizontal portion of this vertical, mortar-side joint should be sloped slight-

ly down toward the outside face of the parapet coping. The backer rod or bond breaker tape can then be installed, cutting it short from each end by the designed thickness of the sealant. The sealant can then be installed and should be tooled to assure good adhesion to both sides of the joint and to provide a smooth, uniform slope to the edge of the parapet. The lack of maintaining the proper width/depth ratio of the sealant during installation is one of the most prevalent causes of premature sealant failure on coping joints.

Moisture Migration Must Be Controlled

This statement is primarily about moisture migration into the roof or wall assembly. However, it also applies to preventing water from running down the face of the wall. If you have ever observed an old building in a northern climate where the water runs down the face of the wall for extended periods of time through the winter (such as with a missing downspout or other concentration of water flow over the edge of the roof), then you have probably seen evidence of deterioration from surface saturation. The deterioration comes from keeping the masonry saturated during the beginning periods of freezing and is usually more severe on northern exposures than on southern exposures for reasons discussed later. Water running off the top of a parapet cap or other adjacent horizontal surfaces must have some type of deflection mechanism such as an anti-drip groove cut into the underside of a limestone coping overhang or an outward hem on the bottom of a metal coping, through-wall flashing, or scupper to keep water from running down the face of the wall.



Photo 1 (above) and 2 (right) show roof flashing installed above through-wall flashing

Except for glazed products, all masonry should be considered permeable, and even glazed units are usually installed with permeable mortar joints. When the surface of porous masonry is in contact with water for extended periods of time, the minute irregularities in the surface of the masonry gradually fill with water. The longer the surface is covered with water, the deeper the water will be

absorbed into the unit and/or the mortar joints. If saturated long enough, it will migrate to the backside of the masonry. When the water freezes, the deterioration process is started.

Cavity walls are not expected to prevent water infiltration. That is why masonry cavity walls should have through-wall flashing and weep holes. It is "Basic Roofing 101" that the top termination of all roof flashings is to be below the height of the weep holes; yet, it is astounding how often this basic principle is ignored, even by some of the largest roofing contractors in the United States (see Photos 1 and 2). When (not if) the wall above the height of the weep holes leaks, it is highly probable that the water will eventually enter the room below the roof or, worse yet, the roof assembly. When counterflashing is used on cavity walls or parapets, it must be installed below the through-wall flashing and weep holes.

If a new tapered insulation system is being contemplated and the weep holes will be too low for the finished top edge termination of the roof system flashings, then the masonry parapet must be reconstructed to raise the height of the through-wall flashing and weep holes. Otherwise, the entire parapet must be covered with a waterproof membrane.

Solid masonry walls do not have a cavity to be drained by weep holes. However, some solid masonry walls still have through-wall flashings at the base of the parapet. If water infiltrates through cracks or deteriorated mortar joints above the through-wall flashings, the result will be the same as stated above if the roof base flashing or counterflashing is terminated above the height of the through-wall flashing at the base of the parapet.

Some moisture migration into masonry assemblies is inevitable, but it must be kept to a minimum. When enough moisture accumulates and freezes, it can move large sections of masonry, leaving open cracks for even more water during the next freeze cycle. Masonry parapets that are exposed on both sides (especially the upper portions) do not benefit from heat loss through the building assembly. Consequently, moisture will freeze quicker in exposed parapets than in the wall portion below.

All deteriorated mortar joints should be re-pointed, with cracked masonry units replaced before re-roofing. Parging the backside of parapet walls with mortar or cementitious coatings is only a short-term solution (see Photo 3).



Let It Breathe

The reason that south-facing masonry usually suffers less deterioration than northern exposures is that the sun increases evaporation during dry periods; therefore, if the wall can breathe, there is less moisture in the masonry assembly during the colder nighttime periods to freeze. When left uncovered, north-facing parapets can

breathe from the southern exposure. Parapet masonry walls must be allowed to breathe.⁴

When the vertical portions of parapets below the bottom of the coping caps are substantially higher than one or two courses above the top of the 8" roof flashing height, the upper portions of the masonry above should generally not be covered with membrane flashing. This is especially advisable with high porosity brick masonry.

Most roof consultants have had to violate this principle from time to time because the cost of proper masonry restoration is much more expensive than extending the flashing height. In general, building owners seem to maintain masonry parapets even less than they do flat roofs. Eventually, the parapet will leak again, the roof covering on the wall will inhibit the drying cycles, and the resulting damage from freeze and thaw cycles will be much more severe than if the wall is uncovered and allowed to breathe.

All masonry coatings decrease the porosity of the masonry surfaces. It is a common tendency for inexperienced specifiers to select a masonry coating that will "seal up the wall." This is faulty thinking, because sooner or later, moisture in the wall will have to get out. Impermeable coatings are often, in the long run, more damaging to the masonry surface than covering the wall with roof flashing or membrane. When coatings do need to be used on masonry, the product should have a very high perm rating. However, eventually the coating will have to be reapplied, and no matter how permeable the product is, each subsequent application will decrease the overall porosity of the coating on the wall.

Vapor Drive Must Be Controlled

Conditioned buildings in cold climates have a vapor drive from the inside to the outside exterior during the winter. Except for monolithic concrete roof decks, the gap between the edge of the deck and the parapet is seldom sealed (especially along the sides parallel to the structural supports.) Sometimes there is an open gap that allows warm, moisture-laden air to infiltrate from the inside, up behind the roof membrane flashing, where it condenses on the back side of the roof flashing and/or into the



Photo 3: Parging with mortar coming off brick above metal counterflashing.

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Photos 4 and 5: Moist air condensing behind roof base flashing and deteriorating brick.

upper portions of the parapet masonry (see Photo 4). The higher it migrates, the more likely it is to freeze and accelerate deterioration of the masonry. If the upper portion of the parapet is left exposed to breathe, the potential damage from freezing will be mitigated to some extent.

Solid masonry walls are less likely to suffer damage from vapor drive and moisture migration in the wall because there is more mass to absorb the moisture over a larger volume, and it also takes longer to decrease its temperature to the freezing point. However, when sufficient water accumulates, moisture in solid walls will also freeze, crack, and cause movement that will result in expensive damage.

Cavity walls (see Photos 6 and 7) should be vented at the top and have weep holes at the bottom to allow the cavity to dry as soon as possible. The vent must be below the through-wall flashing on the exterior side of the building. Consequently, the cavity in the parapet above the through-wall flashing is not usually purposefully vented.



Photo 6: Cavity wall after limestone cap has been removed.



Photo 7: Closer view of cavity wall after limestone cap has been removed.

Depending on the path of least resistance, some moisture can pass the lap joints in most through-wall flashings and up into the parapet cavity where it must be allowed to migrate out of the system.

Thermal bridges and vapor drive migration paths are often very complicated at the roof-to-parapet juncture. One recommendation to decrease the amount of thermal bridging is to fill the cavities of the parapet with a non-settling, moisture-resistant insulation.⁵

Water Repellents

Water repellent applications with high concentrations of silanes or siloxanes help control moisture migration into the wall and still allow it to breathe. These penetrants are not coatings, damp-proofing, or waterproofing materials. Water repellent penetrants, designed for masonry, are liquid applications to the surface of the masonry that penetrate into its depths. When cured,

they resist water penetration by causing most of it to bead up and run off while staying highly permeable (to allow moisture vapor to be released) during drying cycles. Some other masonry wall sealers are not as permeable, impede vapor transmission, and often end up doing more harm than good.

CONCLUSION

"Watch Out: Parapets are Dangerous."⁶ Though a few are dangerous due to poor design, most of the really dangerous masonry parapets are due to lack of proper maintenance and/or improper repairs. If people knew the condition of the masonry parapets in some of our older communities, they would either walk while looking up frequently, or walk on the other side of the street. To be a pro-

professional roof consultant who specifies masonry maintenance or roof flashing design on parapet walls, one should learn the masonry basics and, as in the physician's creed, at least "do no harm." ■

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