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**Moisture Management of Parapet Walls**

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Parapet Walls – What Are They Good For?

Parapet walls perform a number of important functions:

- They can be designed in various shapes to create a desired façade
- They can be designed to hide roof top equipment (AC units, etc.)
- They help prevent roof edge blow off by diverting air flow up, over and away from the roof edge.
- They can be a stable termination point, for roof edges and flashings.

However, even though parapet walls perform a number of important functions, they are moisture management headaches! The phrase ‘Out of sight out of mind’ is, unfortunately, the rule of the day with construction details that are not easily accessible. Parapet walls fall into this category. The required timely maintenance is neglected because of this and regrettably, the need for maintenance becomes apparent only as a result of a failure such as a leak. On top of this, parapet walls have a rather rough life since they are subjected to wind, dramatic temperature changes, moisture from three sides and roof system stresses. The result is a construction detail that is both neglected and abused.

The answer to the question “Why do parapet walls fail?” seems obvious. The solution is just as obvious – design them to be better and maintain them properly.

The most fundamental rules of moisture management “Keep moisture away from, off of and out of a construction detail” and “Move moisture away as quickly as possible” always apply. However, two additional practices should be employed. First, use good moisture management design and identify and isolate the moisture risk zones in such a way as to separate high risk from lesser risk.
Like all structures a parapet wall suffers the fate of its roof – the coping. Failure of the coping is closely followed by wall and interior failure. (See Image 1)

**First Moisture Management Opportunity**

Of all structural components, the exterior building envelope (roof and walls) is the first opportunity for moisture management. The roof of a parapet wall is the coping and like other roof systems, there is a wide range of roofing styles and materials. So designing a maintainable coping system for a parapet wall and maintaining it properly is the starting point for designing and maintaining a parapet wall.

Like other exterior building envelope walls of the past, most parapet walls were solid masonry. As the construction industry’s need for more economical wall systems came about, cavity wall and thin veneer stud walls became the norm, and with the changing construction details came new and unexpected challenges. However, one thing didn’t change – the “environment” that parapet walls have always faced.

Parapet walls come in a variety of shapes and configurations: stepped, sloped, flat, and arched. There are also height variations and combinations of these configurations. (See Image 2)

Regardless of the configuration, they all have top surfaces. How this top surface is addressed can depend on a number of factors (building type, architectural style, building materials, etc.). However, since the top surface of a parapet wall is the roof of this construction component, it must be detailed accordingly. It must be waterproof or at least highly moisture resistant. How waterproofing and how moisture resistant depends on how much moisture is going to come in contact with the top of the parapet and in what form (rain, snow, ice, etc.). Of course there are many other environmental factors to take into consideration (wind loads, temperature fluctuation, etc.).

This decision making process is complicated when climate sensitive architectural styles are imposed into alien climates. (Example: Southwest/Adobe into high moisture Northeast U.S. locations) (See Image 3)

The architectural style requires one look and climate conditions demand another. The moisture management compromises that are required to accommodate these architectural styles, in some cases, are building envelope disasters.
Designing High-Quality Parapet Walls

So how do we design and construct a high quality, maintainable parapet? We start by identifying its moisture management risk factor and that is easy. It is a very high-risk moisture management construction detail with unique moisture management provisions required. The more difficult decision of a designer is where does a parapet wall begin and end? If you are standing on the roof of a building, identifying where a parapet wall begins and ends is easy. If you are standing on the ground looking up at the exterior of a building, the point where a parapet wall begins and ends is not so obvious. (See Image 4)

Once this designation has been made, the next decision is how to isolate this high moisture management risk zone from the other details that make up an exterior building envelope. We can do this in a number of ways. (Veneer surface patterns; veneer materials, etc.) No matter how it is accomplished, a type of water stop should be employed. (Example: a through wall type of flashing system/water stop)

Moisture Moving Upward

Intuitive thinking tells us we only need to manage moisture moving from a high point to a lower point in this construction detail. But the reality is that we also need to be concerned about moisture moving up into the parapet from construction details that are located below the parapet. That's why we need a water stop. The parapet wall and the exterior walls that enclose the interior space (living area) of a building exist in two very different environments.

What makes their environments unique is the fact that the parapet wall has no direct temperature source from the interior of the buildings (neither hot nor cold) while the exterior walls that enclose the interior spaces do. Along with the temperature source difference, there is also the moisture source difference. The exterior walls that enclose the interior spaces may source moisture via vapor drive. (See Image 5)

What is initially thought to be a leaky parapet or roof-flashing detail may well be water vapor that has moved up the cavity of the exterior building envelope, into the cavity of the parapet wall where it is cooled. The condensates then run back down the cavity and into the other exterior building envelope details.
Identify and Isolate Parapet Detail

Identify and isolate the parapet wall detail from the exterior wall detail that encloses the interior spaces and identify and isolate the parapet wall from the building roof detail. (See Image 6)

Once the parapet wall identification-isolation process is finished, we can begin designing a high quality maintainable parapet wall. Focus on the following components (top to bottom):

- The parapet roof (coping) – Zone 1
- The parapet wall – Zone 1
- The bottom of the parapet wall – Zone 2
- The intersection of the back side of the parapet wall and roof perimeter flashing detail – Zone 3

A well-designed coping on a parapet wall should look like Image 6 to best manage moisture. Unfortunately, good moisture management design is not always totally compatible with desired architectural styles. So we compromise, but only a little. Good slope to drain on the top surface of a coping is an absolute must. Any amount of standing/ponding moisture, in any form (snow, ice, water), is a pending moisture management failure for these reasons:

- This moisture can find its way deeper into the coping detail and cause deterioration.
- This moisture can find its way through the coping detail and cause deterioration of other parapet wall and roof flashing materials and details (See Image 7A)

- Moisture can cause excessive stress on coping materials, expansion and contraction stresses from freeze/thaw cycles.
- This moisture can sustain distinct temperature zones that will add stress to the coping detail

Good coping overhang from exterior surface of parapet wall with a well-designed drip edge allows the moisture that runs off the top surface of the coping and down the side surface of the coping to drip freely from the coping.
and away from the wall surface of the parapet. This helps prevent moisture deterioration of the parapet wall in the following ways.

- A well-designed overhang allows run off moisture to drip free off and away from the surface of the parapet wall
- The drip edge directs moisture off the edge of the over hang and prevents moisture back flow back to the surface of the parapet wall (See Image 7B – Good Design and Image 7C – Poor Design)

Good coping anchorage is a must. Air movement/wind can be extremely volatile at this location of the parapet. Building details that are not structurally sound cannot be maintained to manage moisture. (See Image 8 Inadequately Designed Coping Detail)

**Environmental Stress**

Environmental stressors (wind, temperature etc.) were mentioned earlier. Environmental stressors are very real, and they can damage or deteriorate coping materials. What is less obvious is that they can, over time, deform various types of metal coping. One of the more common examples of this is the concaving of metal coping. (See Image 7A)

When sheet metal is bent and formed into a desired shape, stress is built into the metal part and over time, the temperature cycles from hot to cold or from cold to hot allow a releasing of this built-in stress. In this case the sheet metal part is the coping that is trying to return to a flat sheet metal. In many cases this change in shape results in a concave cupping of the top of the metal, this creates a ponding configuration in the coping.

Wind is another stressor, creating movements of other components of the parapet wall and adjoining exterior building envelope details (Roof details etc.) This added movement could deform seams in the metal coping creating openings in the waterproof system. Any available water can then leak into the building envelope.

These environmental stressors can also negatively impact other materials (natural stone, manmade stone, bell tolls, etc.) that are used to create coping.

The design task is to create a coping that is strong, yet flexible enough to allow for expansion and contraction. Copings are truly working, moving construction details and like all mechanical designs that move under stress, they need to be examined occasionally for wear. They need to be maintained!
Adding Slope-to-Drain

When designing a construction detail to efficiently manage moisture, the more slope to drain the better (except when the slope to drain draws moisture from one construction surface to another. This can result in the lower construction surface being constantly wet or flooded. (See Image 9) Unfortunately, this is a somewhat common occurrence on sloped parapets. In many cases the moisture on the top surface of the sloped parapet coping has a tendency to run down the length of the coping instead of off the edge of the sloped parapet coping. This occurs when the overall slope of the parapet is greater than the slope on the top surface of the parapet coping. (See Image 10)

Related Drip Edge and Flashing Issues

Misunderstanding of how a drip edge works on the bottom edge of a sloped parapet coping can result in a similar condition. (See Image 11A). This can also occur on the bottom edge of a cap flashing when a cap flashing is used to protect the top of a parapet wall when installed under a porous coping stone. (See Image 11B) The body of a parapet wall should incorporate the same good drainage design and details of other walls of the exterior building envelope.

Interior Moisture Management System

The interior moisture management components of a parapet wall should include the following:

- A water stop/through wall flashing at the lowest point of the parapet wall
- A well designed weep system at the lowest point of the parapet wall (on the top surface of the flashing)
- A designed detail that allows moisture that makes it through the veneer / rain screen to drain from a high point of entrance to the lowest point of the parapet (the top surface of the flashing) and out of the wall through the weep system. This vertical void is called a rain screen drainage plane in thin veneers and a cavity in brick or other masonry veneers and also a core in concrete masonry unit (CMU) single wythe walls.
- Structurally stable parapet wall; a structurally unstable construction detail cannot be successfully maintained.
- The top of the rain screen drainage plane, cavity or core should be vented if at all possible. (See Image 12)
High Parapet Wall Issues

High parapet walls create real challenges for designers and maintenance personnel. There are numerous legitimate reasons for this type of extreme construction details (signage on the parapet façade, business theme’s, and covering large roof units etc.) but they are not easy to make structurally sound or to maintain. (See Image 13)

The intersection of the backside of the parapet wall and the roof perimeter flashing detail is a complicated, high-risk construction detail. It is always prudent to follow the moisture management rule of identifying and isolating high-risk moisture management details from lower risk moisture management details. In this case it is an absolute must!

So how do you design an effective moisture management system for this intersection of two very high-risk moisture management construction components? You keep the connecting detail very flexible. This can be accomplished with a lapping type of design (cap flashings, counter flashings type of detail) or a very flexible perimeter flashing system that bridges this connection. (See Image 11)