Preventing water damage

January 2023

Introduction

The most litigated issue with building performance is water damage or infiltration. Managing water is serious business. This article will talk only about exterior water sources; and will not include plumbing or interior causes. This paper should be considered an overview, entire articles could be written about any of the subcategories or details.

Why control water

Simply put, we like to be comfortable and dry; and so do our buildings. Water infiltration can reduce the life of buildings or components. Once water damage starts it may require extensive repairs. The source of leaks in an existing building can be hard to pinpoint. It is usually easier and more cost effective to properly control water before it is a problem, than to try and figure things out after damage has occurred. Think of the following situations:

> *A roof that has a hole on the north side may allow water to run along the rafters and drip inside the space closer to the center of the building; finding the source of the leak could be time consuming or difficult.*
>
> *A low slope roof pitched at 1/8" per ft may satisfy the manufacturers, but a roof that is sloped 1/4" per ft will cause the water to drain much faster. Sure, more sloped insulation or more roof pitch may cost more initially, but think about what it would cost to move everything and everyone out of the building for three months of repairs. Suddenly the extra initial cost seems much more appealing*

Water infiltration can lead to mold. This can cause all sorts of building and health issues as well as requiring its own specialized (expensive) remediation. Mother nature is relentless and more water will just keep coming; whether the issue is rain, run off, or groundwater a reprieve is unlikely; so with water management it is best to get it right the first time.

Ways to design for water management

Reduce the amount of water that gets to your building in the first place

_If there is a lot of run off coming down hill toward your house; install a swale and direct it around the building, or construct some drains to collect the water. This way less water will be actually reach the façade or foundation

_Overhangs or awnings will stop rain from reaching window headers or openings

Move the water elsewhere

_Take the rain that falls on the building or site and direct it elsewhere, controlling the water flow

_Move the rain from the cavity wall, over the flashing, out the façade, and away from the building

_ Move the water down the roof, through the gutter and downspouts, directing to an appropriate outlet. Usually the faster you can get the water off the building, the less chances there are for leaks

Stop the water from entering the building

_Build a wall or enclosure, cover it in something waterproof and prevent the water from getting in

Good water management practice involves more than one of these approaches working in combination. If your project includes only one of these methods there is no redundancy, a failure in your system becomes much more damaging. The best construction may be waterproof for 20 or 25 years. What happens when the waterproofing starts to decay or fail? The rain will not stop because the building needs repair.

By default we like to think of inside as being warm and dry; however things can easily go awry. Just because someone builds a wall as an enclosure, that doesn't mean it is properly doing its job or that it can perform indefinitely. A complicated roof intersection that is not properly detailed or flashed, a window sill without enough slope, a joint that didn't receive proper backer rod and sealant; these are all small items which could lead to water intrusion problems. If there is water intrusion, it doesn't usually get noticed until it is visible; by then the damage is often done.

Areas and items that require attention to detail to control water

The roof

Roof itself needs to have the right components and be the right type for the job. The roof slope needs to be correct or sufficient. While 1/8" per foot on "flat roofs" may satisfy manufacturers, it may not provide optimal drainage. Typically the faster or more efficiently you can get the water off the roof the better. Similarly a 4:12 roof may be fine on a southern home where you are only dealing with rain, but up in snow country something steeper may be more appropriate to help the snow slide off.

Roof drains or gutters need to provide enough capacity and be appropriate for the building shape. Sometimes enough capacity per code still doesn't work with the roof shape which can lead to slow drainage and therefore leaks. I have seen large flat roofs with four drains, one in each corner; while the capacity satisfied the code requirements the roof was still not efficiently handling the water. This is mostly due to roof shape, penetrations, bulk heads or other items getting in the way; essentially blocking the water from quickly reaching the drains. Any time water slows down and pools, it can start to seep into somewhere you don't want it. Proper capacity does not necessarily equal sufficient design.

An older townhouse with a large cornice. Aside from being ornamental the cornice helps to keep the rain off the window heads and lets any run off drip to the grade and not get on the facade

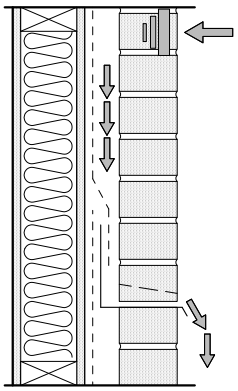
Roof edges should have appropriate overhangs. This keeps rain from dripping on the façade and keeps the water away from window and door openings. Depending on the façade materials roof run off can cause unsightly stains or even damage. Water leaving the roof needs to be planned for no matter what method is used.

Internal gutters are not recommended. These are just prone to problems, and it is my preference to avoid them. External gutters or standard roof drains work better. Sure, if internal gutters are detailed and installed correctly they can work fine; however they can be costly to replace or repair and difficult to find any leaks. Just listen to the terminology, internal gutters, you are bringing the water inside. Why would you want to do that? Letting the water run off the side of the roof is a much easier and simpler way to handle the issue.

Openings (windows and doors)
Provide overhangs at openings; elements like eaves, cornices, and awnings all help control water above an opening. If you can stop the water from even getting to the opening head flashing it has less chance to leak. Again the layered approach to water control.

Head and sill flashing need to be both designed and properly installed. These areas are often overlooked. Just putting a window in place is not enough. Improper or missing head flashing leads to a lot of window leaks. A simple hose test for these items at the right time during construction can help point out any problem areas. If leaks are not discovered until after construction is complete they are hard to locate and often damage other finishes; this may also require removing part of the facade to make a repair.

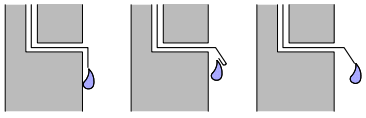
When we build, do we design for form or function? Some people feel that overhangs, awnings or eaves are contrary to modern minimal design, and therefore do not add them to their buildings. Both designers and building owners need to agree on the priorities of the project; is it form or function? I would still ask why can't it be both?



Proper water drainage from a brick cavity wall

House wrap or WRB
Use an appropriate and durable weather resistive barrier (WRB). This is the layer that really keeps the water out; located behind the siding or brick, this is where the water stops and is directed back outwards. In the old days this may have been tar paper or felt. More recently it was Tyvek. Newer and more advanced systems may be product like: zip panels, self adhesive sheets, or liquid applied products. Some of the newer products are more durable and help provide a continuous unbroken layer to keep water out.

Flashings and drip edges
Drip edges are required to direct the water away from the building. They need to have the proper projection and you need to ensure they do not get damaged or flattened out. Drip edges are required at lots of areas: roof edges, window sills, material transitions to name a few. The drip edge needs to be bent the correct way. If a drip edge is not bent the correct way it may not sufficiently direct water away from the building.

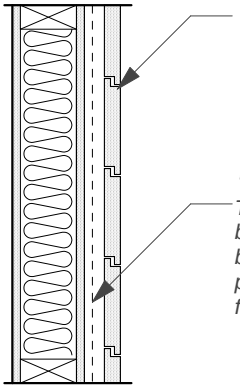


A. No bend in the flashing, and not enough distance from the wall
B. The reverse bend at the end of the flashing will encourage the water to cling to the flashing and drip too close to the building
C. Correct flashing termination. Enough space from the facade, correct clean flashing termination

Flashings often cover transitions between materials; façade to foundation, window sill to wall, or roof to parapet. Flashing can also act to direct water away from the building. Flashings need to be properly detailed and installed, including: termination heights, laps, drainage, and end dams. Unfortunately flashing are often misunderstood and therefore do not always get installed for optimal performance. Proper detailing and mock ups prior to construction can help alleviate any problems. If you don't want to build mock ups, simply being on site to observe when installation starts can help make sure everyone is on the same page. "Ok everyone the window installation is going to begin, let's go through the first install together with everyone on site to make sure it is done correctly."

Façade

A good way to help the façade handle water is by adding a rain screen. A rainscreen is essentially another layer of your façade in front of your inner water control layer. A rainscreen helps the cladding to dry out. It's ok if some materials get wet as long as they dry out. If your clapboard siding was going to get wet in a rainstorm anyhow, moving it forward an inch to create a rainscreen system helps it to dry faster than having it installed directly against the plywood. You don't throw a wet towel on the floor to dry, you hang it up to dry. This creates better air circulation all around; this works the same way with the façade.



When wood siding gets wet, the moisture usually escapes or evaporates by drying outward, though the wood. Moisture trying to leave your wood or clapboard siding by drying outward often causes paint to peel or deteriorate. The back drainage of the rainscreen provides another way for the moisture to escape without damaging the finish. Adding a rainscreen could allow your paint finish to last longer.

Some materials are actually quite porous. Brick will absorb a lot of water, and that's ok, it just needs to be allowed to dry. Materials that absorb water require special details and treatment. Along these lines, painting brick is generally not good practice; as it doesn't stop water from getting in, it just stops it from getting out, which caused spalling and eroding of the brick face.

Keep façade finishes well above the dirt. Lots of materials that go on the façade do not like to get soaked. Run off and roof edge splash can cause decay in the bottom edge of façade materials if they are not far enough above grade.

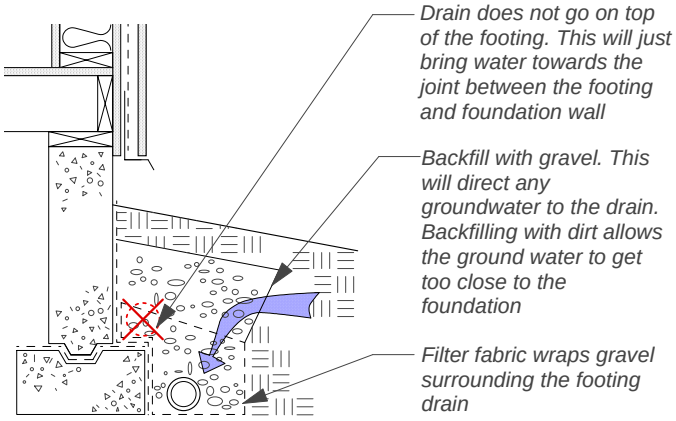
Clapboard or wood siding is a good example. It may be fine initially, but 10 or 20 years down the road it may start to fall apart. This photo is from my house when I first bought it. This siding had been up for a few decades and the bottom edge which was only a few inches above grade had started to decay since it was too close to the ground. If the cement foundation was a little taller this wouldn't have been a problem.

Facade finishes need to be kept a sufficient distance above grade to prevent water damage and rot

Foundation

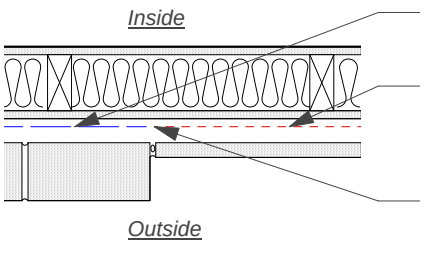
The first step in controlling water at the foundation is to not let water get to the building in the first place. Properly grade the site and surrounding area, provide any site drainage as necessary. Slope the surrounding grade away from the building; both to keep surface water away and to direct roof run off away from the building.

Provide waterproofing or damp proofing, and drainage. Damp proofing (you may recognize as that black goopy stuff on your foundation) is typical on houses and is usually sufficient. More serious waterproofing may only be required if you have: a high water table, deep basement, or are adjacent to a body of water. Simple things like installing enough gravel backfill around your foundation will help provide proper drainage. Using gravel backfill allows the water to drain down to the footing drain; opposed to backfilling with dirt which can let the water get close to the foundation.

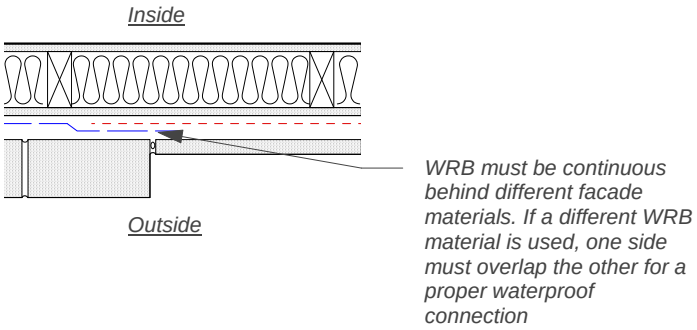


Footing drain. Don't skip this. Don't install it in the wrong spot. Don't let it clog up with dirt. Use a good drain filter fabric (non-woven geotextile fabric that is double punched) and pin it closed in the proper fashion. Just using a four inch drain pipe with a sock is not sufficient for a footing drain. If its not sufficient, why do people install them? They are readily available at big box hardware stores and cheap. At the end of the day footing drains are in the dirt, out of site and out of mind, so people don't want to spend money. Imagine digging all around your house to install a new footing drain after a clog, or repeatedly repairing the damp sheetrock in the basement; it's usually cheaper to do it right the first time.

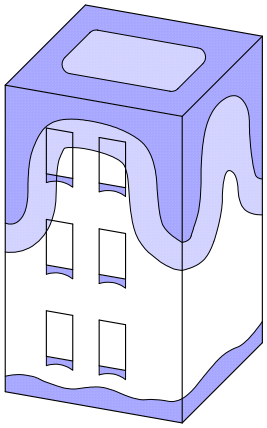
Intersections
This applies to lots of parts of the building; any place where two different materials come together or disparate parts of the building abut each other. This may be where a low roof meets a wall; or where one façade finish meets another. The middle of a material, wall, or roof is much less likely to have problems. Façade material A may be properly designed and façade material B may be properly designed; however if how they join is not properly detailed you can have water infiltration problems.



The concept here is to lap or wrap. One layer needs to lap over the top of the other for an appropriate distance and in the appropriate direction to drain. The two layers can not just stop immediately adjacent to each other and hope to stop water. Intersections tend to be problem points in design and construction. The issue is people shop for parts or materials; I want this material here and that other material over there; how everything comes together tends to be neglected. The water protection layer must be continuous around the entire building. Water will find any small gaps and get inside; even a pin hole in the bottom of a bucket will cause it to leak.



Places where the building gets wet
Buildings do not get wet evenly or uniformly. If you look at a brick or masonry building after a big storm the damp areas may be discernible just by visual examination. Some areas get more wet due to the building shape: corners, edges, and openings. Other areas may get more wet due to: prevailing wind, adjacent structures, changing wind pressures, or the microclimate. Any areas that will experience more wetting should receive increased scrutiny or detailing.



Buildings do not get wet evenly. Typically they get more wet at the top. corners, edges, base, and around openings.

Conclusion
While constructing a building will create new interior space; simply putting up a wall does not necessarily keep mother nature out. Good planning, design, and execution are all required to ensure proper performance over the life of the structure. Water control is best achieved through a multilayered approach. Proper design and installation are usually more economical in the long run than having to repair damage and correct problems after the fact. Hiring an architect or design professional for the duration of the project; from conceptualization through construction will help ensure both proper detailing and execution.

Qualifications:
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