



## Water Intrusion Causes Major Problems Before and After Construction

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*"When buildings leak, the environmental, structural and long term performance can be just the beginning of serious problems and liabilities."*

Many buildings start leaking immediately after construction or show signs of problems within the first five years. Water intrusion is one of the main contributing factors to building damage, litigation, structural damage, rot, termites and microbial problems that can lead to sick building syndrome. For many, water leaks can be like a plague that just simply will not go away. Over the last two and a half decades, we have investigated and focused on these issues that create major problems for the construction team, building owners, and managers. In this article, we shall focus on the *six common questions* most people have regarding water intrusion. These questions will bring to light the common problems and what measures can be taken to limit the effects of water intrusion for residential, commercial, and high-rise buildings.

### (i) How serious is water intrusion?

Every year billions of dollars are spent combating water intrusion and mitigating its harmful affects to unit owners and building occupants. In the absence of water intrusion, conditions are not ideal to grow mold in a house or building, if the mechanical system is designed well to standard specifications with continual functioning. However, if roofs, walls, doors, windows, or grade and below-grade conditions allow water to enter, it can set off a chain of effects that can cost thousands or hundreds of thousands of dollars in property damage. Under such circumstances 'Liabilities' arise. It can create toxic mold problems and harm or even cause death to occupants in exceptional situations. Water intrusion is also a primary source for both structural and interior damage. In the event of hurricanes or other storms or other weather-related conditions, water can drastically increase the physical damage to a structure, leading to high-cost remediation and repairs. Further, if left unchecked, hidden water intrusion can cause serious damage to both the structure of a building and threaten the health and wellbeing of those who occupy it.



**(ii) Why do buildings leak?**

This is a complex question and many parameters have to be looked into when understanding why buildings leak. Simply put, buildings leak when you have the following: (a) Presence of water, (b) An opening or breach in the building, and (c) Forces present to move water to interior conditions.

Forces acting to move water through an opening include but not necessarily limited to

- (a) Gravity
- (b) Kinetic forces
- (c) Surface tension
- (d) Capillary forces
- (e) Air currents &
- (f) Pressure differentials.

Of these six mechanisms, only kinetic forces and differential pressure are a function of water application. The remaining are functions of material properties and play a key role in the material selection in the design phase of a construction project.

Ideally, building assemblies would always be built with dry material under dry conditions, and would never get wet from imperfect design, poor workmanship or occupants. However, these perfect conditions do not exist and their absence can eventually lead to moisture and water intrusion issues.

The four main moisture transport mechanisms predominant in building sciences are (a) Liquid flow (b) Capillary Suction (c) Air movement and (d) Vapor Diffusion. If there are significant water intrusion and mold conditions inside a home or building, most likely one or more of these mechanisms is going to be responsible. Most leaks can be found within what the industry calls the “building envelope.” This includes the roofing, walls, sealants, doors and windows, waterproofing, decks, grade, and below-grade conditions. In a general construction project tens of thousands of pieces/ subassemblies have to come together to build a home or commercial building. Leaks occur when all these pieces do not get put together correctly, either by design or by application of critical components.



Based on thousands of case histories that *US Building Consultants Inc.* been involved with from a forensic standpoint, many leaks occur in the detailing of multiple components that have to come together and function as a complete system. It might be said that, “The devil is in the detailing.” When materials have to intersect or come together (also known as transition or termination points), allowances have to be made to connect or make the two or more dissimilar materials cohesive to one another particularly when flashing and sealants comes into the equation. Assembling multiple components and pieces can be difficult in both design and application practices. If a commercial building comprises of fifty thousand pieces coming together, it is imperative that all have to form one cohesive and waterproofed unit, without which there arises a potential for serious problems.

**(iii) What is the best way to diagnose leak problems?**

US Building Consultants Inc., from its extensive experience terms it as a complex, difficult, and different situation for every building. Although the fundamentals of construction remain the same, each building has its own signature or fingerprint. Every building uses different building materials, components, applicators, and overall design. Since it is not possible to learn all there is to diagnosing water intrusion in a class room setting, practical, hands-on experience is absolutely essential in learning how to diagnose and remediate water intrusion issues.

There are multiple key factors that have to be known prior to trying to diagnose water intrusion issues, as follows:

- (a) Background information about the leak location(s), including how and when it occurs
- (b) An understanding of all attempted repairs that have been made trying to stop the issues
- (c) A clear understanding of the project plans (details) and specifications of the building, and
- (d) An understanding of the transport mechanisms that lead to water intrusion. The other important elements of the successful diagnosis of water intrusion are the processes or protocols used in diagnosing the leaks and the equipment needed to help in the analysis.

USBCI employs hundreds of thousands of dollars worth of state of the art equipment which is used both to inspect and test the building envelope components in a cat-and-mouse game of finding the source(s) of the problems.

Diagnosing leaks is much like an art form that must be developed by extensive on-the-job training (OJT). Diagnosing a leak condition starts by forming a hypothesis. Once the general method by which the water is entering the building is identified, then the analyst starts the process of elimination. Sometimes more time is spent proving what is not leaking rather than what is actually causing the problem. Some leaks are easy, while others can be almost impossible to find and analyze their sources.

Many leaks have multiple sources. The analysts could water-test and examine one location, only to find out later than several sources were creating the water intrusion. This can lead construction professionals to throw tens of thousands of dollars at a problem with mixed results. If done in the proper order by a professional who knows what he is doing, it is not uncommon to stop leaks and issues the first time despite a customer's years of frustration with other services. A recent example was that of a large multistory building belonging to a prominent bank in Pensacola, Florida that had leaked for seventeen years. They spent over one hundred thousand dollars trying to fix the problems and far from stopping the leaks, during the entire time frame. USBCI with its technical expertise had an astonishing success. In a few short months, we



had the building fixed and all of the leaks stopped and our work withstood a hurricane. We received a great letter of reference from the bank and went on to work on several of their bank facilities for them.

Diagnosing leaks should always include inspection, testing and analysis of the leak location and the components or properties responsible for the issues. Once the problem is properly diagnosed, then a solution can be designed to stop the intrusion issues. It should be noted that a prescription without proper diagnosis is malpractice. Playing a guessing game with water intrusion is both costly and dangerous to the building owners and occupants alike. Having a proper protocol and an experienced team is the only way to effectively stop water intrusion issues and their effects in homes and buildings.

**(iv) What are the key problems that continue to cause water intrusion in buildings?**



Some of the key problems are sealants, flashings, poor application practices, poor choice of materials and bad detailing in the design of the building. Sealants and waterproofing plays a key role in the integrity of buildings. Moisture engineering controls focus heavily on the main waterproofing of a building, including but not limited to sealants, glazing, membranes, sheet flashings, sealers, and coatings. Designers and contractors pay very little attention to the building envelope waterproofing details and application practices. This promotes a false sense of security and lack of focus on critical

details that ultimately lead to the majority of water intrusion issues.

One of the key problems that cause water intrusion and its harmful effects is not putting enough attention in the design phase of a project. Detailing of building envelope waterproofing cannot be an afterthought or removed out of the specifications or plans through value engineering. One breach or mistake in a small detail can lead to significant problems with water intrusion.

Another key problem that causes water intrusion is application practices. The construction industry has undergone technological advancement in both application and materials, but a declining expertise in the work force. The building can be designed properly, the products and materials cohesive to one another with good redundancy in waterproofing, but if it is not properly applied or put together based on industry standards, there will be a failure.

Waterproofing is more dependent on application than both a rain screen or drain screen designed system. Application error is by far the predominant cause of water intrusion issues within a building's envelope based on thousands of case histories. The design and detailing of a building runs a close second.

**(v) How do we prevent water intrusion issues?**

To some degree, architects, designers and builders are able to control the number of openings or holes in a building enclosure. While driving forces such as wind and gravity cannot be controlled, they can be influenced by cladding, geometry, flashing, and drainage. In preventing leaks in buildings, building science has shown that every detail should be studied for possible moisture entry. Possible paths of moisture penetration should be traced to determine if secondary seals, flashings or drainage are needed. Because of the tremendous need to understand the complexities surrounding water intrusion issues and their effects, the industry has developed a group of building envelope consultants who specialize in plans and specification reviews, mockup testing and analysis through ASTM standards and construction oversight of the critical items needed to insure a water tight building.

US Building Consultants has been a part of this effort and has trained and certified over seven hundred national consultants and spoken to well over ten thousand individuals on the importance of this topic. These individuals normally possess a strong construction background, knowledge in moisture engineering controls, building science, building envelope remediation practices, and extensive hands-on experience in waterproofing systems and building diagnostics. In today's industry, without employing one of these expert consultants for your building project, it is only a matter of time before a bad experience is going to occur. The odds are stacked against the design and construction team that everything is going to be designed and put together perfectly.

In designing good moisture engineering controls that stop water intrusion, long standing design considerations that are understood by architects enhance the durability and performance of buildings by incorporating vapor retarders, air barriers, ground slope, flashings, weeps, drainage of accumulated moisture, specialty coatings and sealers, thermal breaks, controlled ventilation, overhangs, slope drips, and other key considerations. However, common universal guidelines must be analyzed individually in terms of climate, microclimate, occupancy conditions, interior environment, building envelope components, and more, so that designs produce details that are not only energy efficient and aesthetically pleasing, but effective in resisting against moisture damage. Waterproofing items such as high performing sealants, deck membranes, floor coatings, elastomeric and special coatings, waterproofing sealers, and so on should never be value engineered out or cut back on because of financial considerations. We are of the opinion that if the project cannot afford to keep the important moisture engineering controls and waterproofing in the budget, sometimes it is better not to build and subject the parties to a possible nightmare of events that can go on for years and cost in the millions of dollars.



Building redundancies in the design phase by using innovative waterproofing systems is just one of the keys in providing leak-free buildings. Employing a skilled and reputable waterproofing company is also a key that is many times overlooked in the bidding process, where the low bid

gets the job. The lack of understanding by general contractors of the importance of using the best waterproofing companies continues to be a problem to this day. Failing to use top waterproofing mechanics that bring together all the components in the building envelope through sophisticated waterproofing systems continues to break down the integrity of the waterproofing industry, who are the door keepers to moisture engineering and controls. They are the front line of defense in application that can insure a leak-free building. Sideline this critical element, and mold, interior damage, termites, rot, and angry occupants will be just the beginning of the issues that can arise from water intrusion issues.

**(vi) Does building envelope commissioning really help reduce the risk of water intrusion?**



We are a strong proponent of building envelope commissioning and we have over twenty years of technical expertise. Just recently this has become the new buzz word as more and more building owners and design professionals understand the importance of designing and constructing leak-free buildings. Only by focusing on the patterns of failure and educating those responsible for design and construction can we begin to see a decline in litigation and building failures related to water intrusion. Employing a specialized building envelope waterproofing consultant in both the

design and construction of a building can dramatically help reduce the overall liabilities associated with water intrusion, toxic mold, and premature building deterioration. I have personally seen and been a part of the results of consultants who specialize in this field. If properly deployed on a project before, during, and after construction, the right team is one sure way of reducing the risk that is associated with building construction and latent defects.

***About the Author***

*Scott “Spiderman” Mulholland has twenty-five years’ experience in the construction industry, specializing in forensic investigations and remediation of residential, commercial and high-rise buildings. Mulholland has performed or been involved with several thousand forensic investigations and over two hundred construction litigation cases in his career. He is the President and CEO of U S Building Consultants, which conducts forensic investigations, engineering, architectural and expert consulting services for existing and new construction. He also owns U S Building Laboratories, and is on the board of directors for the Building Envelope Science Institute, which promotes training and certification for the construction industry. For more information, visit [www.usbcinc.com](http://www.usbcinc.com) or call the main corporate office in Gainesville, Florida at (352)505-6771.*