

# YOUR GUIDE

## to Best Practices When Specifying Concrete Waterproofing



SMART CONCRETE®





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# intro

Over the years, an increasing number of design teams have been moving away from external concrete waterproofing products such as membranes. While these are still often considered to be the conventional go-to for many builders and designers, they aren't as effective at improving the waterproofing, durability, and sustainability of a structure compared to some of the more modern solutions like an integral waterproofing system.

But why is that?

Well, while the theory of physically wrapping your below grade foundation in an external membrane sounds logical, it's not so easy to do effectively. There are many worksite obstacles in the way of a successful external membrane application. Whether it's dealing with the concrete surface preparation, the site conditions, the skill set of those doing the installing, or a structure's future building plans, a membrane has plenty of room for failure.

An integral waterproofing system, on the other hand, has fewer issues to worry about. To see just why that is and how you can successfully specify a system for your own projects, we first need to consider the weaknesses of external membranes and how exactly they can be eliminated with an integral approach.





## **Specifiers Aren't Getting the Performance They Need from External Membranes**

At one point in time, the external approach was the only approach available to building professionals. It was understandable to rely on them so much back then as water ingress poses a very real threat to concrete structures and would have needed to be dealt with in some way. But now, with alternatives on the market, it's harder to ignore many of the weak spots involved in an external approach.

### **After All, External Membranes Often Come with a High Rate of Failure**

Almost 80% of complaints for Australian construction revolve around waterproofing according to a member of the Australian Institute of Waterproofing, and it's not hard to see why. They're often prone to failure no matter how well-planned their installation is.

A big reason for that is simply due to how intricate the installation process is. Membranes need proper surface preparation so that their installation area is free of formwork distortions, voids, and protrusions that could tear them. They need a primer to remain bonded to a structure for the rest of its service life. And they need to be free from moisture, which can otherwise interfere with their ability to bond to a structure. All of these requirements take time and attention to do properly and thoroughly. But construction tends to run on a tight schedule. As a result, building professionals often rush through these requirements, which can lead to application problems down the road.

For an example, let's look at this series of photos.



What we're looking at is a pre-applied composite membrane that's been installed in preparation for blindside shotcrete foundation walls.

When you first look at it, everything probably appears pretty straightforward, right? But once you take a closer look, it's clear that there are some warning signs that are going to affect the membrane's performance.

First of all, the shoring shown is actually quite irregular. It has uneven areas and voids, which are going to allow that membrane to buckle a little bit when shotcrete is sprayed against it. That can cause the membrane's seams to tear and fail.

And if you look at some of those seams, you can already see they're being contaminated with dirt even before they've been installed.

Looking further up the wall, you can see there are an awful lot of tiebacks, and those are not easy to detail around. Each one is a potential failure.

They're not the only ways a membrane can fail either. Let's look at a slightly different membrane system.



The number of seams in this membrane are even more numerous. That in turn increases the risk for waterproofing failure.

On top of that, you can see a lot of odd detailing, small patches, and penetrations. The last of which can often be unintentional as subtrades rotate frequently enough for such small items to be easily missed. These can pose a potential tearing concern for membranes.

It all goes to show that even the smallest of missteps in an already complicated external membrane application can become a huge risk for failure.



### It's Led Some to Go with a Hybrid Waterproofing Approach

The developer of The Paramount is one of them. Wanting to protect their project from the risks of a high water table in Richmond, Canada, Keltic Development Ltd. chose to apply two waterproofing systems instead of one. The first of which would be an external membrane system. And then, to mitigate any damage if it failed, the developer also applied an integral waterproofing system.

[Learn more.](#)



## Once Membranes Fail, Repairs to the Membrane Itself Are Impossible

When concrete is installed alongside a membrane, the membrane itself will not actually be accessible for repairs. So any breaches in that membrane that allow water in will remain and expose weaknesses in the concrete, enabling water to leak into your structure.

Now, of course, any repairs now need to be made to the concrete itself. This can be done either by managing some sort of rout and pack, where you chisel out the crack and pack it with a waterproof grout, or drilling and injecting a flexible urethane foam to seal off that water.

Whichever you do, the responsibility for waterproofing a structure always starts to shift from the membrane that was originally installed to the concrete itself as it becomes increasingly patched up over time.

With that in mind, it'd be much more efficient if you could simply design the concrete to be fully and permanently waterproof on its own.

### The Result of Membrane Failures Can Still Be Resolved Via Krystol® Technology

While membranes are not easily accessible for repair, the concrete itself can still be repaired with Krystol technology. The health-care company DHAMAN recognized this, so as soon as the membranes for two of their Kuwait hospitals failed and started leaking, they turned to the Krystol® Leak Repair System. That allowed them to quickly and permanently stop the leaks from occurring.

[Learn more.](#)





## It's Time to Look for a More Integral Approach

An integral waterproofing system makes it possible to transform concrete into its own permanent waterproof barrier. All it requires is that you add the waterproofing directly into a concrete mix and install the necessary support products that should be with any waterproofing system.

## It's a Way to Keep Concrete Watertight with No Application Concerns

It's also as simple as it sounds. Just add a crystalline admixture to the concrete mix in the back of the ready-mix truck, and that's the majority of the work.



There's no need to prepare or prime the concrete or worry about moisture affecting the application of this type of waterproofing. It's just added to the concrete mix where it can permeate the concrete entirely, fully waterproofing the material.

Of course, you'll still want to keep an eye on quality control, but that can be done at the batching yard. It is easy enough to do and allows the admixture to give the mix its own waterproof properties.

This type of waterproofing isn't a new concept. It has been around since the early 1980s and was meant to replace the need for external membranes. After all, membranes are known to tear easily, so what better way to avoid that than by creating a form of waterproofing that can't be torn?

It seems too good to be true, but integral waterproofing has been proven to be an effective solution.

And it gets this reputation through the use of its crystalline technology. This technology, depending on its manufacturer, is designed to react to either unhydrated cement particles or free lime in the concrete once it comes into contact with water. That reaction creates an interlocking structure that will grow throughout the concrete's interior matrix, making it permanently part of the concrete.

It's not something that can be washed away, broken down, or worn out over time. Instead, the structure maintains a very solid presence, filling up any voids and micro-cracks in the concrete to block water and waterborne contaminants from entering them. And any time more water is introduced, the structure will grow further, providing continuous waterproofing protection over the years.

### Many Prefer Krystol® Technology for Their Integral Waterproofing

While there are different crystalline admixtures on the market for an integral waterproofing system, hundreds of building professionals choose to go with the Krystol technology found in our Krystol Internal Membrane™ (KIM®) admixture. To show just why that is, we offer our technical data sheet, which lists the solution's benefits, recommended uses, properties, certifications, and more. [Learn more.](#)



Essentially, this technology self-seals the concrete, reducing the size of surrounding shrinkage cracks and fixing hairline cracks. Some forms of it can even hold back up to 140 m (460 ft) of hydrostatic pressure.

In short, it's the ideal waterproofing solution. There is no complex application needed, eliminating the risks that come with that. And it becomes a permanent, unbreakable part of the concrete, protecting it for the rest of its service life.

## It Can Also Be Great for Corrosion Resistance

Certainly, lots of design teams are concerned about waterproofing and keeping water in or out of their concrete structure. But the durability of the structure's reinforcement is also critical and in some cases, more important. Low permeability is one of the best predictors for reinforcement durability, especially against corrosion. So in addition to helping produce watertight buildings, integral waterproofing systems are also often capable of providing corrosion resistance.

An independent study on this was performed by the University of Hawaii from 2002 to 2012 in the Honolulu Harbor. During that 10-year time period, researchers tested waterproofing admixtures and a number of other permeability-reducing products, corrosion inhibitors, and other materials. They applied them to concrete samples and placed those samples in a splash-and-spray zone in the harbor. That left those samples in a severely corrosive environment that also contained chlorides and carbonation.



### Corrosion Isn't the Only Structural Concern That These Admixtures Can Prevent

A recent study conducted by Kryton and the University of Ottawa has shown that certain crystalline waterproofing admixtures could hold the key to future alkali-silica reaction (ASR) mitigation. Those with self-sealing features could modify the kinetics of ASR, slowing down how much deterioration might result from the reaction.

[Learn more.](#)



A number of these performed poorly, including the control sample, which showed significant signs of corrosion and corrosion-induced cracking during the testing time period. However, the crystalline-treated sample performed well. It had no corrosion-induced cracking, no evidence of corrosion, and maintained low half-cell readings throughout the testing period, proving that an integral waterproofing system using a similar product could be both watertight and corrosion-resistant.

## **Performance-Based Specifications Are Key to Making It All Work**

No matter what integral waterproofing admixture you choose, it's not yet a complete system on its own. It can only waterproof the concrete, not the rest of the surrounding structure.

To give your structure full protection, your waterproofing specification needs to include not only the concrete but also its joints, penetrations, and waterstops. You're also going to want to ensure that any American Concrete Institute (ACI) performance recommendations are followed. And it will be equally important to involve the waterproofing solutions manufacturer in your structure's design review so you can ensure that all the involved products and systems are being used to their fullest effect. It's also an opportunity to review any warranty coverage the manufacturer might offer, such as product and extended performance warranties.

Of course, this process is easier to complete when you have an in-depth understanding of integral waterproofing admixtures and their performance. A good place to start is with the *ACI 212 Report on Chemical Admixtures*.

This report, created by ACI members, specifically describes permeability-reducing, or waterproofing, admixtures in its 15th chapter. Under its description, these admixtures are classified into two different types: permeability-reducing admixtures for non-hydrostatic conditions (PRANs) and permeability-reducing admixtures for hydrostatic conditions (PRAHs).



PRANs are admixtures that act more as a water repellent. They do that through the use of hydrophobic materials, such as soaps, vegetable oils, or petroleum. These can help the concrete shed rainwater and even reduce efflorescence. But they don't actually seal the pores of the concrete against hydrostatic pressure. So they're better off used as a form of dampproofing that can mitigate some impact of light moisture ingress.

Meanwhile, PRAHs are recommended as a solution for long-term waterproofing and as a replacement for external membranes. They typically use some sort of hydrophilic polymer plug or crystal technology. Both use a physical pore-blocking mechanism to seal off the pores and capillaries in concrete and resist very high water penetration, which is what makes that concrete waterproof.

However, not all PRAHs work so effectively. So if you're using a PRAH to design a waterproofing system, take a look at some performance benchmarks before specifying it. To start, you'll want a PRAH that's demonstrated that it can reduce permeability between 50% and 90%. This needs to be verified with a suitable test method that uses direct hydrostatic pressure to simulate the actual conditions your structure will be exposed to.

With that in mind, you might want to look for results from the DIN 1048-5 test method. It's designed to model a real-world environment, and it does that by applying hydrostatic pressure to a concrete sample for three days at 0.50 MPa (72.5 psi). Afterwards, the sample is broken in half so that the depth of water penetration can be measured.

This isn't the only test available, and there are many waterproofing admixtures on the market. So it's crucial to scrutinize them thoroughly.



For admixtures, keep in mind that manufacturers often make similar claims and use similar language in their literature. So carefully examine the details of an admixture for the following:

- What the admixture does exactly
- How it resists hydrostatic pressure
- How well it tests
- Whether it has an ability to seal cracks
- Who's tested the admixture

### An Admixture's Performance Can Contribute to LEED Points

Depending on its quality, a waterproofing admixture could increase a project's LEED points. Oxford Properties Group got to see this for themselves when they added KIM admixture to their Eau Claire Tower project. The end result left their project with LEED Platinum certification and other sustainability certificates.

[Learn more.](#)



For tests, make sure they come from credible sources. If they were conducted solely through the manufacturer, it's likely there will be more bias involved. But if a valued third-party testing company like the ACI or the British Board of Agrément prepared the concrete and tested it, you know the test results will be reputable.





## An Effective Integral Waterproofing Strategy Uses a Comprehensive System

As briefly mentioned before, an integral waterproofing system does not just consist of a concrete waterproofing admixture. Or at least the most effective ones don't. They also need supporting products to protect the rest of the structure around the concrete.

### One Key Part Is the Waterstop

While admixtures can't stop construction joints from coming into contact with water, waterstops and waterstop-related products can. Just like their name suggests, they are designed to stop water from reaching the joints. And combined with a waterproofing admixture, they form part of a system that makes a concrete structure that much more watertight.



Of course, how much more watertight the structure is depends on the type of waterstop application you choose for your integral waterproofing system. If you go with a full waterstop system like Kryton has, you have three forms of protection you can use independently or all together.

The first is a crystalline slurry. It's a chemical barrier that uses the same technology as Kryton's own waterproofing admixture. Once applied to a construction joint, its technology will activate in response to water, filling up any possible pathways for the liquid to travel through.

The second form of protection is a combination of the crystalline slurry with a high-strength, low-shrinkage grout. That ensures there are two barriers, one chemical and one physical, to halt any water ingress.

The third form of protection is the use of the crystalline slurry and grout alongside a hydrophilic rubber. It's typically recommended for high-risk, deepwater projects as it provides the highest form of protection. Under it, a concrete structure can block water out chemically with the crystalline slurry and grout, receive fiber reinforcements from the grout to limit cracking and shrinkage, and reap the benefits of a swellable hydrophilic rubber that can seal the joints physically away from any water. No matter which form of protection you choose, it will still provide your structure with additional waterproofing, further reducing the risk of water ingress.



### Waterstops Are Not as Valued as They Should Be

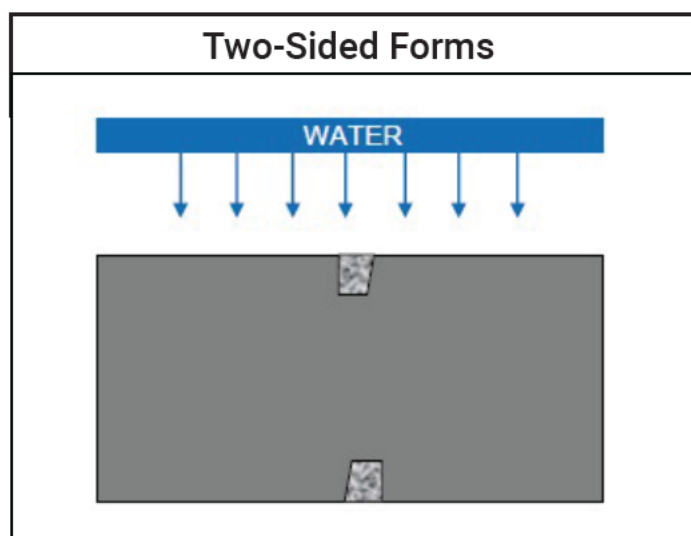
When building professionals think of waterproofing a concrete structure, they mainly think about the specification and use of external membranes or concrete admixtures. But that isn't giving products like waterstops enough credit. Waterstops especially are a great form of protection for construction joints. To explore why that is, we conducted an interview with Kryton Territory Manager Christian Warren. [Learn more.](#)

## It's Not Fully Optimal without Effective Crack Control

Even with both a waterproofing admixture and a waterstop support system, a concrete structure will still crack. With a self-sealing waterproofing admixture, this is mitigated a little. But even then, cracks can be disruptive during the construction phase. In fact, it's been observed over time that the most common control joint spaces seen in foundation walls just don't provide an optimal level of crack control you'd want from watertight construction.

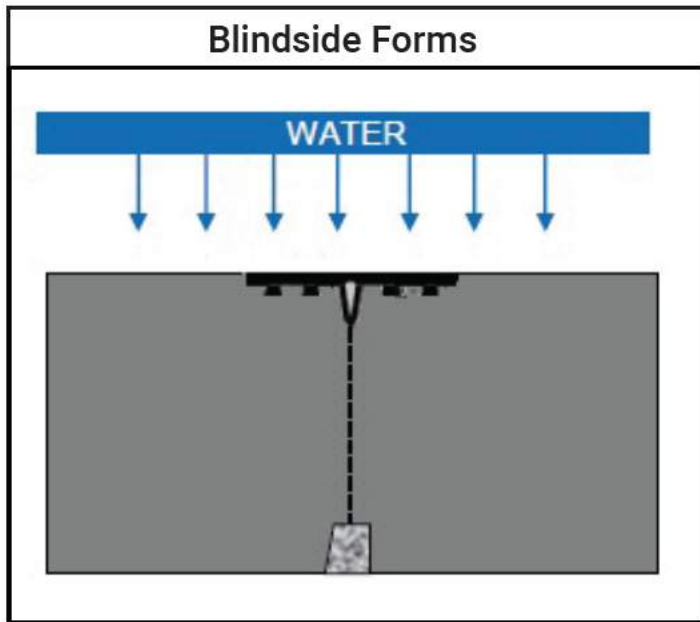
To remedy that, you want an effective form of crack control. Typically, this means placing the joint spaces every 3–5 m (10–15 ft). Though, you may want to keep it closer to 3 m (10 ft) for when you're working with shotcrete. Either way, this can help virtually eliminate random cracking in your structure's walls and make the walls themselves look quite neat and orderly. That in turn can save you time and money on a project as repairs will be less necessary under such circumstances.

There are two ways to make this happen.



If you have two-sided forms where you have access to both sides of the wall, you can cast a keyway on either side. That will create a plane of weakness. It forces the crack to develop right where you want it, where it's convenient for you to repair it. Then, you can simply grout it and not have to worry about it again.





Now, if you have a blindside form, particularly with shotcrete, the process is a little bit different. In this case, you should install a base seal polyvinyl chloride waterstop. That provides some negative-side protection and a crack-inducing element, which will be aligned with the keyway and will later be grouted for extra protection.

### There Are Many Ways to Improve Concrete Crack Control

Cracks are a common part of concrete construction no matter what you do. However, building professionals recognize this and have come up with a number of solutions in response. We've summed up some of these prevention, control, and repair solutions in a three-part series on our blog.

[Learn more.](#)



Whichever method you go with, your concrete structure will benefit from it greatly, keeping its integrity and appearance fully intact to ensure your integral waterproofing system and everything installed alongside it works optimally.



## Quality Assurance Must Be Considered at All Stages

While an integral waterproofing system's application is much easier than that of an external one, its quality assurance will still depend on effective construction management.

### That Starts in the Pre-Construction Phase

Before construction even starts, you should make sure that you and your team have thoroughly reviewed your chosen integral waterproofing system. After all, you need to make sure this system meets your project's particular needs.



A good way to start determining that is by reviewing all waterproofing details with the system's manufacturer. For instance, there are a variety of joint details you want to make sure you're using the correct products for in the correct way at the correct locations.

There is also an opportunity at this point to submit your concrete mix design to the manufacturer to get their review. That will provide you and your team with advice or guidance on how you can optimize your mix for watertight construction. It can even give you insight into what admixtures can be used in tandem with the system to ensure they're compatible.

Once that's all determined, you'll also want to schedule a pre-construction meeting for the entire project team, including both the ready-mix company and the waterproofing manufacturer. It will offer everyone involved a chance to clarify the set roles and expectations for that particular project. And more importantly, it'll provide an opportunity for those involved to receive waterproofing training to ensure products are installed for maximum effect.

### Take This Time to Check What Support Your Waterproofing Manufacturer Offers

If you go with a manufacturer like Kryton, you'll have the option for extra support with the Krystol Assurance Program™ alongside our integral waterproofing system. With it, you won't have to worry about attempting to secure a waterproofing site review or training. Instead, you'll be guaranteed both along with a 10-year material and labor warranty. That ensures your integral waterproofing system will work in the most optimal condition. [Learn more.](#)



## Quality Assurance Remains a Factor Before and After Concrete Placement

Even though the pre-construction reviews will set your construction in the right direction, you'll still need to consider other key aspects. One in particular is the layout. You'll want to inspect it in its entirety before any concrete is placed to ensure that all waterstops and waterstop-related products are installed in the correct locations and that all joints are spaced correctly. It's also important to remove any water debris from the joints so that workers can properly pour the concrete to encapsulate the waterstops.

Once the concrete does start arriving, don't forget to make some additional record-keeping notes. These should include all the necessary details about the delivery of your waterproof concrete so you can refer to and double-check them later for efficiency.

Then, after the concrete is finally in place, the last and most important step is to check that the concrete is cured. There are standard curing procedures described in *ACI 308*,

such as the use of wet curing or an *ASTM C309* curing compound. But you'll still want to thoroughly review this process as its effectiveness is crucial for minimizing concrete cracking and getting the best possible performance out of the concrete.

Throughout this entire process, if the waterproofing system manufacturer has any inspection checklists related to waterstops, jointing, or concrete placements, make sure you're aware of them. These can be a useful resource to help you catch any sub-optimal details.

### Another Way to Improve Concrete Placements Is Via Sensors

Keeping track of all your concrete placements to see how well they perform can be difficult when doing so manually. And in some cases like with San Francisco's Southeast Treatment Plant and its 300 to 400 placements, it can be impossible. It's why the treatment plant's upgrade team chose Maturix® Sensors. These allowed the team to monitor each placement remotely through one platform simultaneously.

[Learn more.](#)





## It Doesn't Necessarily End After Construction Either

After construction is finished and the project has been handed over to the owner, there may still be some work to do. For one, an owner is going to be concerned about the maintenance of their building. While integral waterproofing systems are inherently durable and low-maintenance, there may still be some crystal formations growing around concrete cracks as they seal. This can look alarming to an owner, but it's completely normal. The crystal formations are not harmful, and if desired, they can simply be cleaned away during routine maintenance.

Another aesthetic concern that could crop up is painting. The owner might wonder if the admixture part of the integral waterproofing system will affect the adhesion of a concrete surface. Fortunately, there is no adhesion loss to worry about with integral waterproofing. If an owner wishes to paint their walls, they can still paint them.

### Concerns Like These Should Be Easily Answered by the Manufacturer

If you encounter similar concerns, the manufacturer of your waterproofing system should be able to provide you with more clarification and guidance. For instance, if you went with Kryton's system and had questions about our admixture, KIM, there is a thorough FAQ sheet dedicated to the solution. [Learn more.](#)





If you want a watertight concrete structure, you're better off taking an integral waterproofing approach over an external one. After all, an external approach with membranes can be vulnerable to tearing and difficult to install or repair. Meanwhile, an integral approach eliminates all those challenges.

It instead takes advantage of a crystalline waterproofing admixture and surrounding waterstop and waterstop-related products to provide one thorough waterproofing system. With this system in place, you can transform your concrete into a permanent waterproof barrier that is incapable of tearing and keep all the surrounding details just as protected.

On its own, it will do a much better job at keeping water out. But there are ways to optimize its protection even further and maintain quality assurance. These include maintaining best concrete crack control practices, conducting pre-construction waterproofing reviews, supervising waterproofing product installations, and guiding owners when necessary on the finer details of your integral waterproofing system.

Combining all of these elements allows you to eliminate most risks to concrete waterproofing without sacrificing the structural and aesthetic needs of your project.