7 THINGS YOU MAY NOT KNOW ABOUT CONCRETE SLABS
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Concrete is the world’s most frequently used material for construction of all kinds—from bridges, dams, and skyscrapers to walkways and building foundations. And it’s no wonder! Structurally speaking, concrete is esteemed for its strength, durability, and versatility.

Like many things in life that seem to be everywhere we look, we often take concrete for granted. Because of that, most of us don’t realize how concrete actually works. Given the fact that concrete is an exceptionally hard building material, a lot of people fail to appreciate how water, cement, and aggregate (or rock) serve as the three most essential components that comprise concrete. In fact, without water, concrete would not be concrete at all.
Despite its outward appearance and how it feels to the touch after it cures, concrete is not a solid material. It is filled with tiny air pockets and veins, or capillaries.

When first poured, concrete contains “batch water” as part of the mix. During concrete drying—a process that usually takes many months—much, but not all, of this water gradually evaporates from the surface of the slab. As this takes place, small air pockets and veins form within the slab.

Additional batch water then gets pulled into the air pockets through a process called capillary action. Then the water moves upward to the surface where it evaporates.

The rate at which the concrete dries can vary considerably and will depend on several factors:

- The ambient conditions (temperature and relative humidity) and the amount of air movement across the concrete’s surface.
- The drier and hotter the surrounding environment, the faster the concrete slab will dry.
- Conversely, in a humid environment, the concrete may dry quite slowly or it may even absorb moisture, depending on whether the air is holding more or less moisture than the slab.

As drying occurs, a moisture gradient will form in the slab, with significantly more moisture deep down in the slab than at the surface. If the slab gets sealed with a moisture-impermeable flooring product that keeps moisture from evaporating, the gradient will disappear, and the moisture within the slab will even out, or equilibrate.
HOW MOISTURE COMBINES CHEMICALLY WITH CEMENT TO MAKE CONCRETE

(AND HOW THE MOISTURE THAT DOESN’T MUST EVAPORATE)
Concrete is a mixture of water, cement, and aggregates. The water and cement combine to form a paste that coats the surface of the fine (small) and coarse (large) aggregates.

Through a chemical reaction called hydration, the paste hardens to form concrete. Hydration occurs quickly after the water is added to the mix. Getting the right proportion of ingredients is key to achieving strong concrete.

The amount of water in the mix may surprise you. A certain amount of “excess” water is always included. This is needed to help with pouring and shaping the concrete mixture. After the initial pour, the excess water must be allowed to evaporate. Without evaporation, the concrete will simply be much too wet for its intended use.

Initially, the concrete will be at 100% relative humidity (RH). After the concrete dries sufficiently, would it surprise you to learn that the concrete’s RH may still be at least 75% or higher? Sound way too high? It’s just one indication as to how important water is for giving concrete its unique structural characteristics.

Thus, it is not accurate to say that concrete ever reaches a state of complete dry-ness. No matter how dry it may appear to the eye, concrete always contains a surprising amount of water—which, of course, must be there to give concrete its desired strength and durability.
Concrete, like many other building materials, constantly interacts with the surrounding conditions. This means that even when a slab is deemed “dry,” things can easily change. Let’s look at several ways that excess moisture could be introduced to the concrete from various outside sources.
GROUNDWATER

In any structure, groundwater can become a source of slab moisture because of either a high water table or natural moisture levels of the surrounding grade. This is particularly true if no vapor retarder has been installed.

Builders often install vapor retarders before pouring a concrete slab. Put simply, a vapor retarder impedes external moisture vapor from migrating into the slab from the ground. This focuses the drying process ONLY on the excess water in the concrete mix and eliminates the potential for the ingress of seasonal moisture from the ground.

WATER LEAKS

Sprinklers, appliances, and plumbing—anywhere that water is directed through or near a slab—can become a major source of excess concrete moisture, especially if damage to a pipe occurs. Undetected leaks could cause significant moisture-related damage to installed flooring or other building materials.
INADEQUATE GRADE

Natural run-off from rain, snow, sprinklers, or other factors can be exacerbated if the grade slopes toward the structure instead of directing moisture away. If this is the case, in addition to a vapor retarder, you should consider extra measures such as external sealants, drainage systems, sump pumps, or specialized landscaping.

HIGH AMBIENT RH

The internal conditions of a building should be thought of as external to the concrete slab. When the relative humidity of the air is higher than that of the concrete, the slab will absorb moisture from the air until it reaches equilibrium.

POOR DRAINAGE

This is directly related to groundwater and grade. If drainage is inadequate to handle the levels of moisture that surround a building, pooling or overflow may occur, which can impact the concrete and other building materials in contact with it. This is best addressed during design and construction.
At least two or three variables potentially affect each truckload of concrete once it is delivered to the construction site. First, drivers may add more water if they get stuck in traffic or sit at the job site waiting to unload. Water may also be added to the concrete to make it more workable when it is being poured. Afterward, while the slab is drying, it may be exposed to the weather. This can also significantly affect moisture levels.

These factors introduce considerable variability in the moisture levels within the slab. It’s never safe to assume that moisture levels are consistent across the job site—even if all the concrete came from the same mix of cement, aggregate, and water. This is why RH concrete moisture testing guidelines require that you place one test for every 1,000 square feet of concrete, or about the area that one truckload can cover.
Can concrete ever be considered lightweight? If you've ever picked up a concrete block, you know that concrete is a pretty dense building material. In other words, it is noticeably HEAVY. Yet, there's one type of concrete that is termed lightweight. How can that be? Standard concrete typically uses crushed natural stone as the coarse aggregate in the mix (along with Portland cement, water, and sand). Natural stone is relatively dense for its size, adding to the weight of the concrete mix.

Lightweight concrete uses a variety of alternate aggregate materials. These may include porous rock like pumice, manufacturing byproducts such as fly ash or slag, or clay, shale or slate that has been heat-treated to create internal pores in the aggregate. The net effect is a lower mass per volume. Lightweight concrete may also be “foamed” by introducing tiny air bubbles into the mix to reduce the final concrete weight.

Interestingly, reduced structural weight can be considered an advantage for many types of applications. But the disadvantage is that lightweight concrete tends to retain moisture, increasing the drying process by two or three times. Lightweight concrete's increased drying times contribute to a higher incidence of moisture-related flooring failures, which is why surface-based methods of testing for moisture can be problematic. It is also why ASTM International has specifically disallowed calcium chloride testing for lightweight concrete.
We’ve already touched on the importance of using the correct amount of water in the concrete mix. If there’s too much water, more water must evaporate after the concrete cures, which equates to a longer drying time.

If possible, avoid using curing, sealing, or bond-breaking agents. They will likely inhibit evaporation from the concrete’s surface and increase drying time.

Ambient conditions are also critical for fast drying times. This cannot be emphasized enough. If the air is humid or cool, the concrete will dry much slower. Once the slab has cured, enclose the space as soon as possible, keep doors and windows shut, run the HVAC, and use fans to circulate air.

Another factor that might negatively impact the drying process is power troweling and/or polishing concrete. Never over-trowel the slab’s surface. This will block the pores in the concrete, reduce moisture evaporation, and increase the drying time. Polishing and sealing the concrete before it is fully dry can also be problematic. While a polished concrete floor is visually appealing, if done too soon, it’s an invitation for a moisture-related disaster.
Concrete is hard, and it’s strong. Everyone knows that. But did you know that water is the ingredient that most affects how strong the concrete is?

That’s right. Water is key.

However, this doesn’t mean that more water is better. Indeed, it’s generally thought that less water produces a stronger, more durable concrete.

Too much water means there will be more shrinkage as the concrete dries, leading to more cracking and reduced compressive strength. Most experts recommend a water to concrete ratio of less than .5. You also increase the porosity of the hardened concrete with too much water, as more capillaries and air pockets will form as water moves to the surface of the slab. The upshot: a significant reduction in the concrete’s compressive strength and durability. Concrete with trapped air levels at around 10 percent will experience a reduction in strength of up to 40 percent.

On the other hand, too little water can be just as concerning. For one thing, the hydration process and the curing of the concrete may be significantly affected such that the concrete will not be strong enough to meet your structural needs. Bottom line: for strong, durable concrete, you absolutely need water in the mix—if you include water in the right proportion. Too much or too little water and you end up with concrete that lacks strength.
Sure, concrete may look and feel perfectly dry. But water is always there. It has to be. If the present amount is too high, however, it could easily lead to unacceptable levels of damage to various aspects of any construction project. Before proceeding with a floor covering installation, for example, you should always test the concrete for its moisture condition.

Keep in mind that only one test has been scientifically proven for accuracy and reliability: the in-situ RH test. This is the test method you’ll want to use if you’re working on a project that involves a concrete floor slab, and you wish to evaluate the slab for moisture.

WHAT IT ALL MEANS FOR YOU

For fast, accurate, reliable testing of concrete moisture, more people turn to the Rapid RH L6 concrete moisture testing kit than any other. To learn more about moisture in concrete or how best to test for it, contact Wagner Meters at (877) 721-8376, or visit www.wagnermeters.com.
GLOSSARY OF TERMS

Batch water – the water that is used along with cement, aggregate, and other minor components to form the concrete mix.

Capillary action – the process that facilitates the movement of water through concrete as it dries.

Hydration – the chemical reaction that occurs after cement and water are combined and that facilitates the hardening of the concrete mixture.

Relative humidity – the amount of water vapor present in the air compared to the amount the air can hold.

Vapor retarder – a membrane that is mostly impermeable to water and impedes the migration of moisture from the ground to the concrete slab.