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# The Ultimate Handbook on Proactive Concrete Moisture Testing

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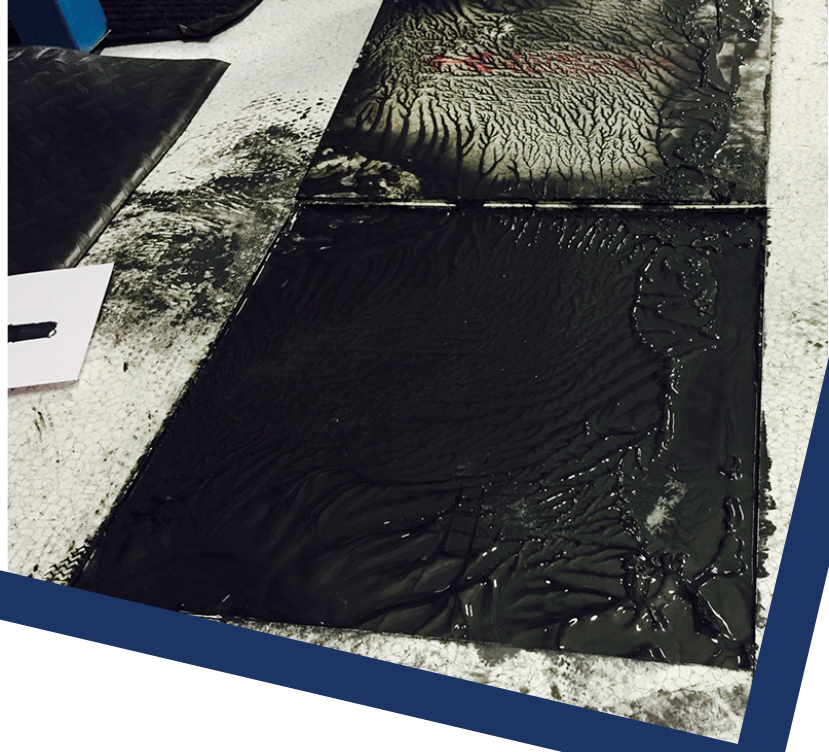
## Introduction

Concrete slab moisture testing is not only an essential component of any flooring installation, it's a requirement. Concrete moisture can lead to numerous expensive and time-consuming problems associated with flooring, and is one of the most prevalent causes of flooring failures. Industry experts know that approximately 85% of all flooring installation failures result from moisture problems, and account for more than $1 billion in damages annually.

**Taking a proactive approach by testing concrete prior to the installation of flooring rather than after it has failed not only saves time and money, but can also limit legal problems down the road.**

This guidebook has been developed from the findings of 20 years of data collection and hands-on experience in concrete moisture testing. Its purpose is to provide a comprehensive overview of how to address end eliminate issues related to concrete slab moisture in a proactive and cost-effective manner. It will address concrete moisture from all angles, so that whether you're a building owner, architect, general contractor, or flooring installer, it will provide the information necessary to make "concrete" the reasons why decision makers must work as a team to ensure successful flooring installation by addressing potential concrete slab moisture systematically and proactively.



## 1. Understanding the Causes of Concrete Moisture Problems

To understand the reasons why concrete moisture is a prevalent, yet avoidable cause of flooring failures, it's necessary to begin with the basics of concrete science.

Concrete is typically a mixture of cement, water, coarse and fine aggregates and admixtures. Depending on the intended application for the concrete, different proportions of each material will be used in the mixture (mix design) to develop the necessary properties of the concrete.

The cement, when mixed with water, forms a paste that acts like glue and holds the mixture together, a process that strengthens the concrete as the water evaporates. Here, moisture has a positive relationship with the concrete, as it enhances its strength.

Unfortunately, however, flooring materials react adversely to moisture, so the balance (or imbalance) of beneficial moisture and adverse moisture is the crux of the concrete vs. flooring materials dilemma.

Another important factor is that concrete typically begins its life at a basic pH of about 13; however the pH values at exposed surfaces decrease as reactions occur between carbon dioxide from the atmosphere and alkalis in the concrete— a process known as carbonation. When adhesives used to install vinyl flooring or carpet tiles are applied to concrete with pH values exceeding 9, the pH level, along with moisture, can cause the adhesive to break down. This can lead to a shorter floor shelf life, and to floor failures.

So why are concrete flooring problems such a prevalent issue?

**Reason #1: Modern day construction timetables are growing shorter and shorter.**

With the rise of fast track construction and advances in technology, what used to take a year to build can now take a matter of months. Unfortunately, however, the time it takes to place, cure, and dry concrete has not decreased accordingly. To accommodate the shortened schedule, many products have been developed to either accelerate the drying time and/or block the moisture at the surface of the concrete. These products can be effective, but are neither foolproof nor guaranteed in the long run. As a result, flooring is sometimes installed on concrete slabs that are assumed to be prepared to receive flooring, however the moisture content is actually well above the manufacturer-specified moisture limits of the flooring products.

**Reason #2: A vapor retarder is either ineffective or not present.**

A vapor retarder is the most effective means of protecting floor coverings from under slab concrete moisture. However, for many years, the construction industry did not require vapor retarders as a standard practice on all concrete slabs intended as the foundation for floor coverings. And in some cases, when vapor retarders were used, they were improperly placed, and/or made from low grade materials that deteriorated over time. As a result, many aged concrete slabs in building structures today are not properly protected from sub slab moisture.

**Reason #3: Changing environmental regulations**

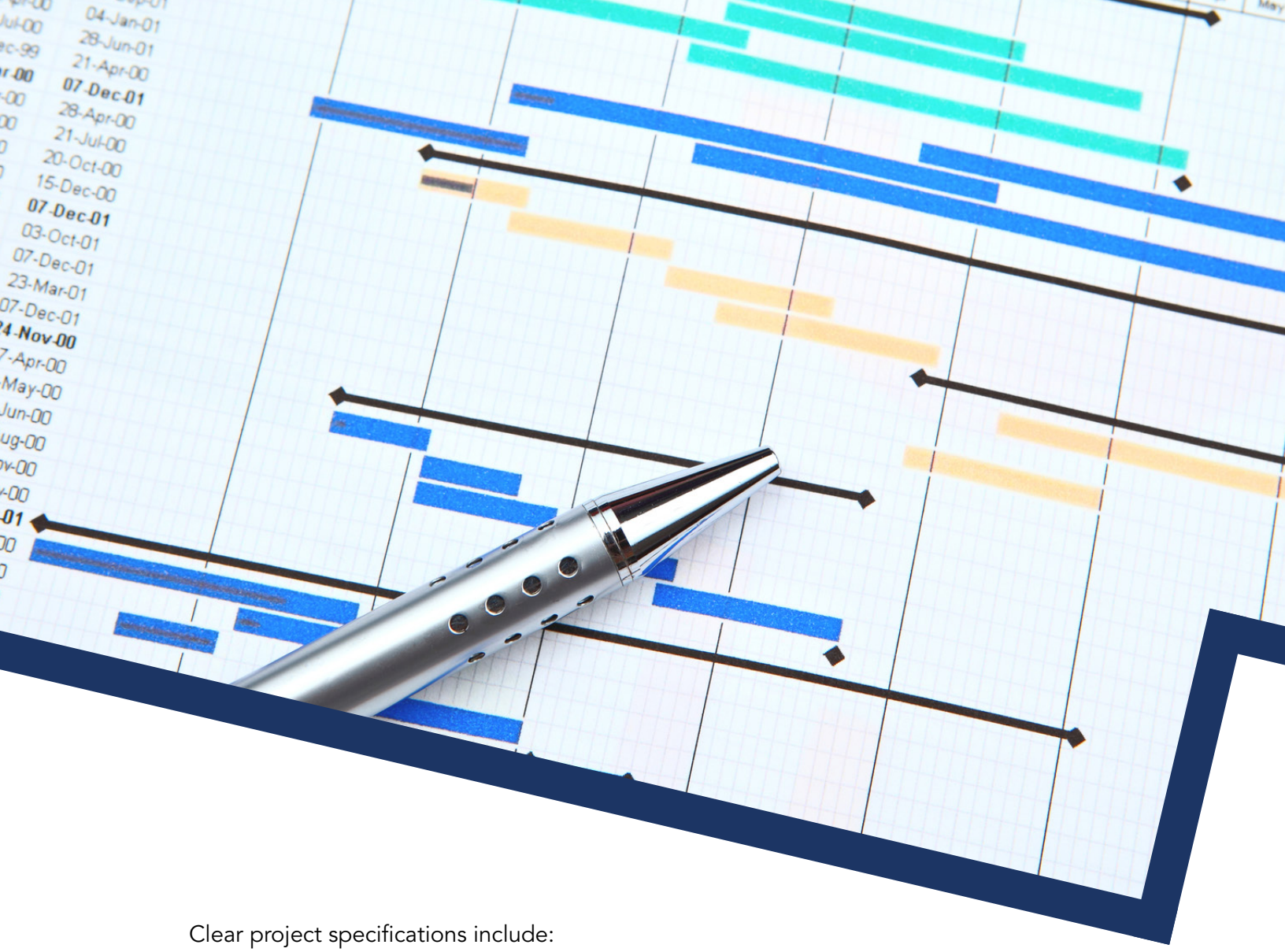
The flooring industry, its products, and its byproducts are all regulated by various federal, state, and local agencies. Changes in regulations have forced manufacturers to reformulate their products to remove many of the harmful chemicals, resulting in products that are more sensitive to concrete moisture. Many dangerous solvents have been removed from adhesives, and asbestos is no longer an ingredient in flooring material.

**Reason #4: Lack of clear project specifications**

In many cases, construction project specifications are extremely vague, simply suggesting that concrete testing should be conducted or offering general manufacturer's requirements for concrete moisture. There is no mention of who is responsible for the testing, when exactly the testing will be done, or even what will be done as a result of the tests. This lack of clarity can lead to a host of problems.

**Clear Project Specifications as a Proactive Solution to Concrete Moisture**

To prevent moisture-related flooring problems, everyone involved in the decision-making process regarding concrete slabs and flooring, from the architect to the flooring installer, needs to have clear, detailed, project specifications.



Clear project specifications include:

- Detailed information regarding manufacturer's guidelines for the moisture tolerances of the flooring and adhesives that will be used in the project.
- **The company that will be performing the tests**, in order to ensure the quality and accuracy of the testing.
- What will be done if the moisture results are above the limits of the flooring specified.

Given the above, if high moisture is identified, the plan for addressing the moisture is already in place.

But without these types of specifications, the flooring installer is left to make the decision about installing the flooring, which is typically either to install it without a warranty, or suggest a product to block the moisture. In this case, the general contractor and/or owner is forced into making a decision based on a lack of information, and trusting someone they may not have a working relationship with. This uncertainty typically leads to friction and conflict, all of which can be avoided through clear specifications.

## 2. The Benefits of Hiring an Independent Flooring Inspection Company

### Proactive planning and scheduling

An independent flooring inspection company can take on operational responsibilities such as scheduling the certified inspector to conduct the necessary testing. Working closely with the general contractor, they can participate in the timeline creation so that the concrete is tested not only within the correct testing conditions, but also within the project timeline. Some can also provide an account manager to work closely with the contact person on site.

Adopting a proactive approach to moisture testing allows the entire construction team to plan ahead, knowing that the necessary data will be collected to confirm that the selected flooring products are the best for the job, and that the flooring itself has the best chance of being installed successfully.

### Establishing appropriate testing conditions

Before testing the concrete, an independent flooring inspection company will ensure that the building is in the appropriate condition for conducting the tests, which means:

- Windows and doors have been installed and enclosed;
- HVAC system is up and running;
- The building temperature and relative humidity are at the expected normal operating conditions for a minimum of 48 hours prior to and during testing.

**Numerous testing services**

On a site by site basis, an independent flooring inspection company can offer a wide range of flooring-related services, from pre-installation site evaluations to post-installation flooring failure analysis.

Since they're not directly involved in the construction project, their independence allows them to objectively inspect the project without bias or conflict of interest. Having a flooring inspector on site provides an extra set of eyes to make sure best practices are followed.

It's important to note that only some certified flooring inspectors are also certified concrete slab moisture testing technicians. As experts in both, these technicians assess projects at a much deeper level than most inspectors.

### Specification Review and Rewrite

As previously mentioned, many flooring projects begin on the wrong foot because of unclear or imprecise moisture testing specifications. Ideally, the flooring inspection team will work with the project team to review and update the specification to the most current standards and best practices. If the specification has already been published, the flooring inspector can go above and beyond the requirements of the specification to eliminate the possibility of a flooring failure down the road.

### Detailed Reporting

A certified inspector will perform a thorough investigation, record observations and test data, and document all testing through photographs. Once all of the information has been reviewed, the internal technical team will generate a report and can provide recommendations for the next steps, whether it's moisture mitigation, a product reevaluation, or simply an "all clear."

## 3. Timing in Concrete Slab Testing

Because there are a multitude of professionals involved in the construction and maintenance of a commercial building, the "best" time for anything can be a somewhat subjective decision. But when it comes to concrete slab moisture testing, there really is a best time. The key is planning ahead, and knowing the conditions of the environment where the testing will take place. Some of the timing scenarios to consider are:

### New construction

As mentioned above, concrete slab testing during a new construction project must be conducted when the building has all of its doors and windows installed and enclosed, the HVAC system is up and running, and the temperature of the building has been maintained at normal use conditions for at least 48 hours. That way the moisture will be running through the concrete at the same rate it will be when the building is in operation.

These conditions are not only optimal for concrete slab testing, but are also the requirements per ASTM standards, as tests performed outside of these parameters will provide unreliable data.

### Remodel project

Remodel projects create an opportunity for concrete slab testing -- even months before the scheduled remodel, prior to the final scope of the remodel. This allows factoring into the budget the costs and timing for the floor replacement.

In the best case remodel scenario, concrete moisture tests are conducted well in advance of the remodel, and before or after hours, so that normal operations aren't interrupted. Once it's time for the work to get started, the moisture tests will have been completed, and the recommendations written into a report.

Another benefit of early testing is that anyone bidding on the remodel project will know which products to include in the bid, leaving much less opportunity for surprises or change orders.

**Flooring failure**

Obviously, the best time for testing in case of a flooring failure is sooner rather than later. But what's even more important is that the concrete is tested not only where the flooring is failing, but also (if possible) in a place where it's still in good shape. A field technician should gather multiple samples in multiple locations for comparative purposes. In this case, more is always better.

**Other recommended times for concrete moisture testing**

Another important opportunity for concrete moisture testing is when a building is being considered for purchase or tenancy. In this case, a field technician can conduct a host

of tests, including a sub-slab condition inspection, also known as coring. The purpose of this test is to assess the quality and location of a vapor retarder. In these situations, the field technician will core through the concrete slab and determine the presence, quality, and location of the vapor retarder. This information can be extremely useful in predicting the life of installed flooring.

**Why is timing so important?**

When a new slab is tested too early, it can result in false readings showing high moisture. In scenarios like this, the general contractor overseeing the execution of the project is faced with the following choices:

1. Delay the flooring installation
2. Proceed as planned without flooring warranty, or
3. Implement a costly moisture mitigation system.

Delaying the flooring installation usually will not occur, because this pushes back the remainder of the project, adding substantial cost. Knowing this, the party in charge of the flooring will ask the owner for a "hold harmless" and release them of the flooring warranty, creating exposure to potentially paying for a floor failure.

## 4. Understanding Floor Failure Costs

The remaining option the flooring contractor or general contractor will suggest is a change order to add a moisture mitigation system. Here's how these costs can stack up:

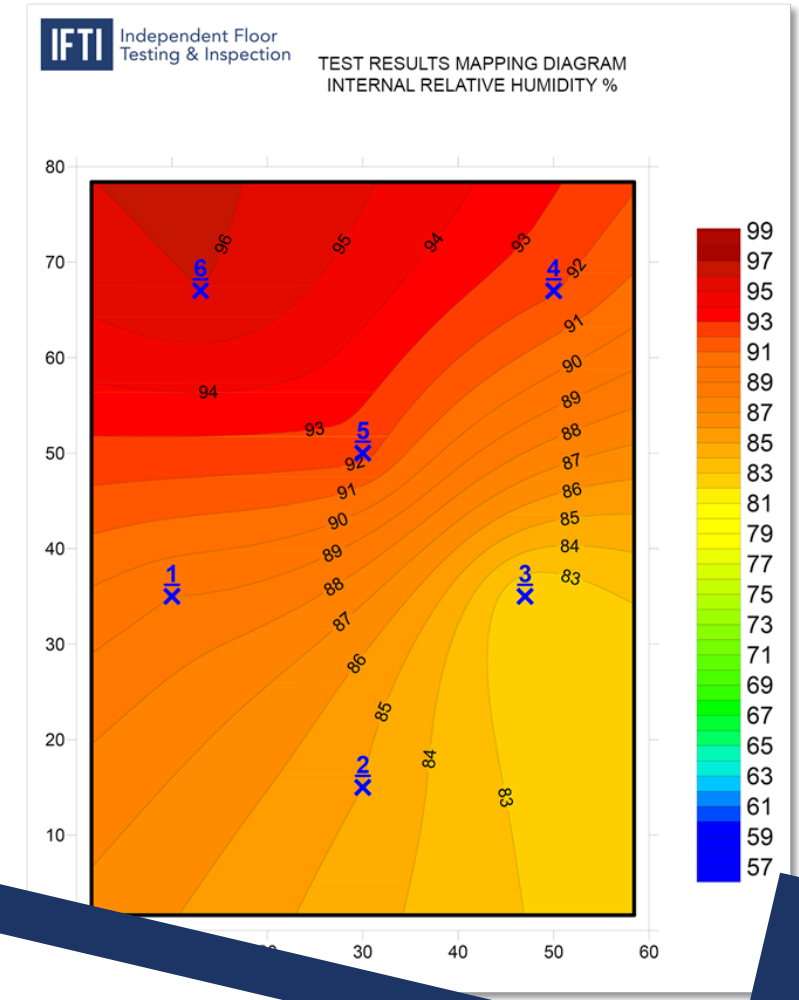
| Floor Failure Scenario | |
|---|---|
| Building size: | 20,000 square ft. |
| Cost of flooring installation: | $2 per sq. ft. |
| Cost of removal of floor installation: | $1 per sq. ft. |
| Cost of new floor & moisture mitigation: | $5 per sq. ft. |
| **Total:** | **$160,000** |

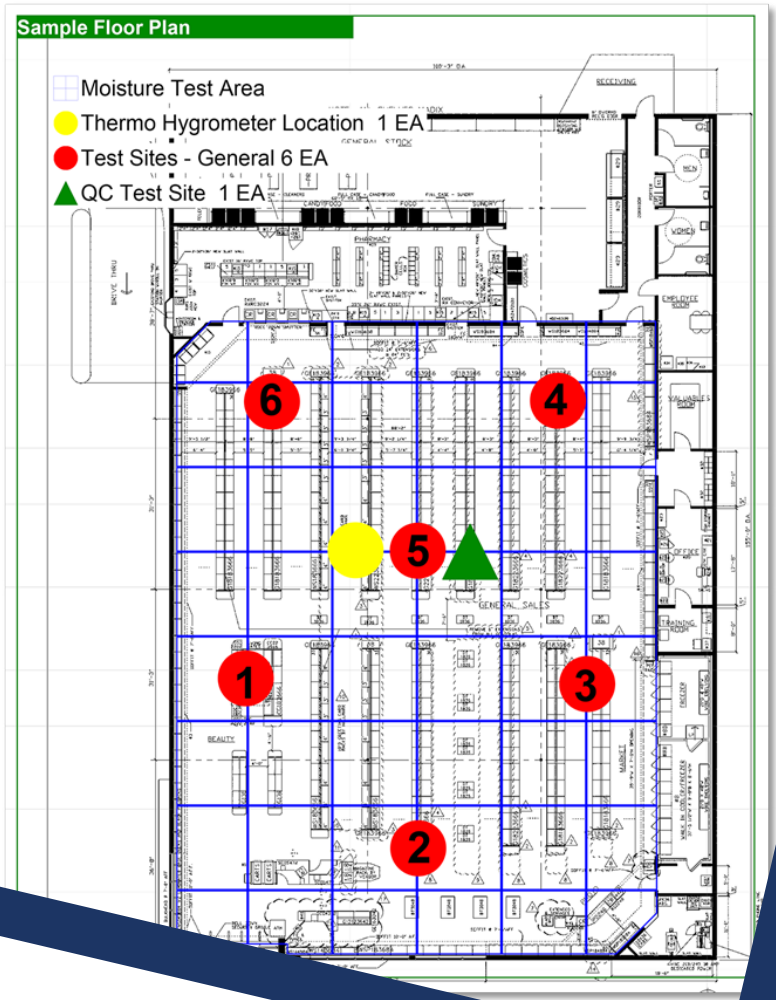
| Moisture Mitigation Scenario | |
|---|---|
| Building size: | 20,000 square ft. |
| Cost of moisture mitigation: | $4 per sq. ft. |
| **Total:** | **$80,000.00** |

If the moisture testing isn't conducted by an independent, third-party moisture testing company, an owner might be concerned whether the data is accurate and if the change order was needed at the cost quoted. Owners want to make sure they're only spending money where it's necessary.  Having an independent moisture testing company perform the tests can give you an unbiased, expert opinion, to help you make your decision. The approximate cost for testing before laying down the flooring:

| Proactive Testing Scenario | |
|---|---|
| Building size: | 20,000 sq. ft. |
| Cost of moisture testing: | 20¢ per sq. ft. |
| **Total:** | **$4,000.00** |

Investing in proactive concrete moisture testing conducted by an independent, third party testing company **early in the game** makes a lot of sense, but is an option that is often overlooked.




## 5. Moisture Tests for Concrete -- Methods that Work

Before, during, and after conducting the moisture tests for concrete, a team of professionals should work together to assess the conditions of the building, the materials in use or planned for use, and the concrete throughout the building, to create the most comprehensive assessment possible, allowing customers to make highly informed decisions.

Once the assessments have been made regarding the materials and the condition of the building, comprehensive moisture testing can begin. The tests that will be conducted are determined by the information gathered prior to testing.

Field technicians conducting concrete moisture testing should fully document the testing process. In the best case scenario, they capture the test site in high resolution photos, and record the tests through detailed data documentation. A certified field technician should gather a wide variety of information to provide the most accurate, detailed picture of the concrete and its surrounding environment.

The data and documentation from the field technician should be further examined by objective, third-party certified concrete moisture testing professionals to ensure that all

of the data is valid and usable. Thorough examination should include cross-referencing the photo documentation and test results before a report is sent to the customer.

As the final step of the process, the customer should receive all of the information in a certified moisture test report, including the photo documentation. To ensure the best value for the investment, a certified concrete moisture testing expert should be available to consult with customers or answer any questions they might have after receiving the report.

## 6. Conclusion

Proactive concrete moisture testing is an extremely important, yet often overlooked aspect of any flooring installation project. As concrete moisture testing experts can tell you, the primary benefit of proactive concrete moisture testing is just that -- it's proactive.

In any complex project, the most effective implementation methods include processes that allow decision-making based on reliable information. This is what proactive concrete moisture testing provides. Rather than committing time and money to a flooring installation and simply hoping for the best, by conducting comprehensive, professional concrete moisture testing **before installing flooring**, decision makers are given the essential information necessary to move forward with confidence. This not only greatly increases the likelihood of a successful flooring installation, it also greatly decreases the chances of an expensive and time-consuming flooring failure.

Moreover, the expertise and skills provided by a concrete moisture testing company can have a positive effect not only on the flooring installation, but on additional aspects of the project, such as planning and project management, which can save a significant amount of time and money in the long run. With clarity and professionalism as fundamental components of the construction project, questions of responsibility and liability are easily resolved, eliminating the headaches and hassles of potential litigation and other expensive risks.

Hiring an independent, third party moisture testing company leads to better project management, reliable testing methods and reporting, reduced risks, and a high level of professionalism throughout the flooring installation process.

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