AC•TECH
Allied Construction Technologies, Inc.
When Performance Counts!

Technical Bulletin; 12

CORE TESTING, DESCRIPTIONS AND PROCEDURES:

Question: Why should I do any testing at all? This is a common question that many applicators ask. Usually the answer comes when a problem has manifested itself on a just completed floor-coating project. In the litigious atmosphere in today's floor contracting world the better question would be "why would I not test?" Testing is a way the installer can take a "snapshot" of the condition, content and make-up of the concrete that is about to be coated. By testing for various constituents, or contaminates in the concrete, the applicator is making sure that the concrete to be coated is in fact sound and in a condition that will allow for the application of coatings[1]. (I.e. adhesion or bonding issues, silicates, weak cap, ASR, etc.). With the information that the test results will reveal, the applicator is better armed to be pro-active with potential problems or any additional work that may be necessary to successfully remediate or complete the project. AC•Tech strongly suggests that under certain circumstances core testing be conducted to protect the applicator, final flooring installer, the final customer, and to validate our 15 – year warranty.

The photos below show what you may run into when an older building has been purchased for "re-purposing". Knowing the history of what activity went on here will be of prime importance when it comes to the flooring installation. By the time the flooring installer gets on site, all the nasty material in the photos will have been removed and cleaned up, but any resulting contamination will still be in the concrete slab! KNOW WHAT YOU ARE DEALING WITH BEFORE YOU ARRIVE ONSITE. Do not find out through forensic core testing after the flooring you applied has been installed and failed that the concrete slab was loaded with oil, organics and other contaminates-everyone will look to the applicator, "you should have known…" or "why didn't you ask for cores to be taken before you started?" Don't get left holding the proverbial "bag".

Contaminated concrete floors do not always look like the photos, sometimes they look "normal" where you cannot see, smell or feel the contamination on the deck surface. The contamination may be well below the surface of the slab or may just be invisible to the eye. This is the reason for taking pre-job cores, to let you know precisely what is in or on the concrete.

[1] Refer to ACI 201 Committee Report "Guide to Durable Concrete" Publication ACI 201.2R-01

For example, the floor on the right doesn't look too bad, some surface dirt and debris; a good shotblasting will take care of that! But, you really have no idea of what is in this slab other than it looks OK. Any historical information you can gather from commercial real estate agents or the local town hall as to the facilities former usage, will be helpful; In the case of this floor, this warehouse was used in the 60's as a storage facility for old electric transformers and not only oil is present but possible PCP's as well making this a hazardous-HazMat abatement project as well! Core testing will reveal all this and more; eliminate any surprises; especially the ones that will cost you money, know what you are coating!

How much testing should be performed? Core testing requires that a sample is cut and removed from the substrate usually in the form of a cylindrical (core) sample in what we call a "short core". These drilled cores are usually 2" in diameter and 3" in depth. On a smaller size floor, 1K to 3K sf, you may want to take 1 or 2 cores for sampling. These should be taken in random areas on a concrete floor after any demolition (old flooring removed) but prior to shot blasting.

On larger floors 10K to 30K sf and up, as many as 4 or 5, and on a very large floor, 50K sf and up 6 – 10 or more may be requested.[2] There are no set rules or guidelines for the amount of testing samples that should be obtained, it is up to the individual applicator, facility owner and/or the condition, (or suspected condition), of the slab to be coated that will establish this amount.

The number of core samples taken will be predicated by suspected contamination area & type of contamination observed, economics (costs) and time. Usually at least two of these restrictions will come into play on any given project.

If stains were present on the floor or other obvious signs of surface contamination, an additional core in this area may also be prudent. The more you know what is in the concrete the better you will be able to make recommendations for coatings and any remediation or additional repair procedures that may be required.

However, do not make a decision for a coating recommendation based solely on the core sample test results; take into account all factors as they may relate to the particular floor that is to receive the coating system. These are, (but not limited to), Core tests, Calcium Chloride moisture testing[3], humidity readings, pH readings, past history of the facility, original cement mix design (if available), age of concrete, vapor or no vapor barrier under slab, slab cracks and signs of abusive use, prior coatings history, etc.

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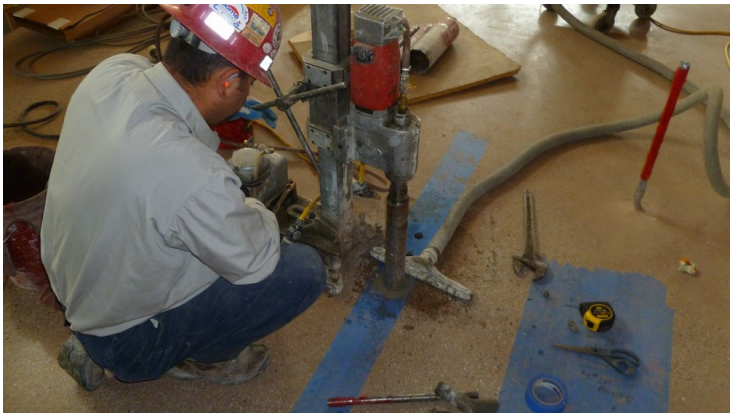
[2] These numbers are suggestions only; it is up to the individual applicator to establish these guidelines.

[3] Calcium Chloride vapor testing: ASTM F 1869-98; A quantitative method to measure the amount of water emitted over a specified area. See www.ASTM.org.

Be aware that the testing performed on any core sample is for that particular concrete sample core only and that the testing lab (or you) will make no claim for the rest of the floor area. It is very possible to have a core sample come back from the lab as "clean" and directly adjacent to it heavy contamination that will reject all coatings.* ***Make sure that all individuals/groups that are involved in the project are in this communication loop and are aware of the core sample disclaimer!*

Two types of core sample drills from different manufacturers; the drill on the left has a water pump (red hose) for cooling, lubrication and dust control. A core bit is shown on the left as the large red tube.

Taking cores can be a messy & tricky job perhaps best left to a professional company or sub.



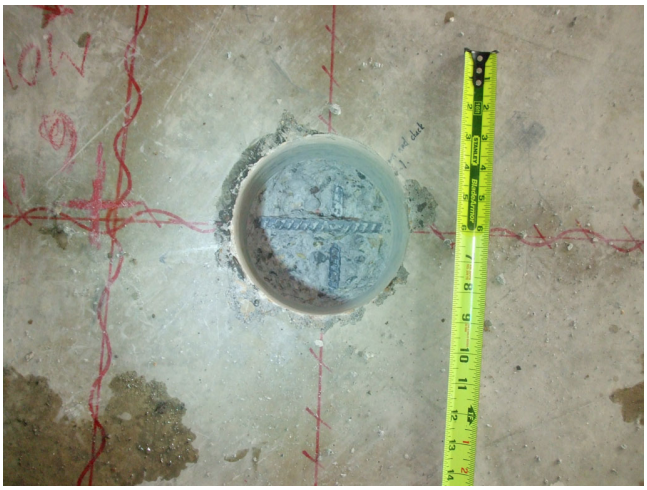
<u>CORES SHOULD BE 3" DIAMETER X 2" DEEP</u>- ***NOT ALL THE WAY THROUGH THE SLAB!***

Removing the "short core" after drilling with two screwdrivers. Gently rock the two screwdrivers back and forth in the saw-kerf and the core will pop out for removal. Again, note the mess created on the floor due to the wet drilling. The depth of the core being taken in this photo is shown on the core drill bit where the white paint has been worn off. There is no need to penetrate the entire thickness of the slab unless there is specific reason to do so.

Who should pay for the testing, who is responsible? Any testing or lab work that is required to complete a successful coatings project would usually be paid for by the owner of the facility or the party to whom the applicator has submitted his quote to. As mentioned in the previous paragraph the key word in this case is "suggested". It is the responsibility and "*Due Diligence*" of the installer/applicator to perform or at least ***suggest*** these procedures to his customer prior to any coatings being applied to a suspect slab. The installer/applicator must do all he/she can to make sure that the concrete to be coated is in an acceptable condition (according to ACI 201) to receive the coating system[4].

If the General Contractor, Owner or Owner's agent refuses to authorize or pay for the "suggested" tests, then the installer should get the refusal in writing and place it with the Pre-Project Checklist for future reference. Having this letter of refusal may greatly remove the installer from liability if there are problems later on. The installer in this case has performed his "due diligence" in offering to perform the coring and then take/send the samples to a proper lab to have them professionally analyzed.

Make sure all cores taken are labeled, numbered and a simple map is made as to where each core was taken. This will be valuable information if only one or two cores come back listed with contamination, especially if there are multiple rooms or divided sections of the floor in question. Bag each core as soon as it is taken to avoid any accidental contamination from outside sources. Pack in appropriate shipping container to avoid breakage during transit to the selected lab.



Be careful not to hit any rebar or post-tensioning cables with the core drill. If these are found, simply drill elsewhere and properly patch the hole. Treat any nicks in the post-tension cable per specifications of the post tensioning.

Repairing a core hole with an epoxy type mortar. Fill the bottom of the hole with aggregate stone and/or sand. Be mindful of the surface traffic load and use the appropriate type of filler material.

[4] Refer to ACI 201 Committee Report "Guide to Durable Concrete" Publication ACI 201.2R-01

Bag & Tag:
When taking the cores, it is very important to bag and tag each core as it is pulled from the concrete slab. The reason for this is twofold, 1) so that it's location is known to all when the results of testing are returned and contamination areas are outlined and/or further core testing is required to further define the area in question; 2) so that no outside or accidental contamination can be picked up on the core that will be measured during lab testing. Remember that contamination in these tests is measured in "parts per million" so an accidental brushing against anything oily, such as an oily floor or table or even plain table salt will impact the test results and give erroneous readings that if undetected, may cost a lot of money in unnecessary remediation procedures.

Make sure to include a letter providing the number of cores, date sent, name of the project, your company name and address and appropriate contact numbers for the lab in case there are questions or concerns. Also provide a list of tests to be performed on the cores; the AC•TECH technical staff will assist you in this detail. Also make a note in the letter that the AC•TECH technical staff is to be copied on all results and analysis when the testing is complete.

LIMITATIONS OF CORE SAMPLING:

Please remember that any sample core taken from any specific floor whether in failure or not, is only indicative of that particular 3" X 2" area of the concrete and whether it is "clean" or contaminated an assumption will then have to be made for the rest of the floor. LIMITATION: Clean cores may be obtained in an otherwise very contaminated floor which may then compromise the subsequent coating systems. Remember, you may have a "clean" core in one location and a few feet away you may have catastrophic contamination. Any contamination discovered is *assumed* to be at a minimum where any or all of the flooring failure exists. TAKING CORES AND HAVING A "CLEAN" REPORT *DOES NOT* GUARANTEE THAT THERE IS NO CONTAMINATION. ***Please, always make all parties aware* of this important limitation prior to obtaining core samples.**

WHAT TESTING SHOULD I ASK THE LAB FOR?

THE TEST METHODS FOR EVALUATING HARDENED CONCRETE: [5]

The following are some of the more common tests that are to be performed or *offered* to the customer by the installer prior to the preparation of the slab for any given project. These tests require a sample, (drilled; 3" X 2" core), be taken and sent to an independent testing laboratory for analysis. Please check with the test labs that you deal with to establish a lead-time and cost for these procedures and build the time line and cost into your project time frame & budget.

***NOTE: If you have any questions on these procedures or have had the tests performed please contact the AC Technical department for assistance. Please have the lab selected copy the AC Tech technical staff on all test results and analysis.**

1. "IR" Infrared Spectroscopy Analysis: Checks the sample for organic contaminates in the concrete such as hydrocarbons, oils, fats, fatty esters, etc. This is a test that is highly recommended for all coatings applications on older concrete.

2. "IC" Ion Chromatography Analysis: This is primarily used to check the concrete cap for water soluble salts such as reactive silicates from curing or hardening agents applied to the slab after it was poured, potassium or sodium chlorides. If these salts or reactive silicates are not identified and

[5] This list is not to be construed as the only tests available or that may be required for a given slab.

a coating is then applied, the un-reacted (meta) silicates will act as a bond breaker and any surface applied coating systems may delaminate from the substrate and the salts will cause a high alkalinity value. This is an inexpensive, but critical test, and should be offered *in all projects* where it is not known weather the concrete contractor used an integral (batch-mixed) or after-pour treatment.

3. **"XRD" X-ray Diffraction:** This test determines the general inorganic makeup of the concrete matrix. The results of this test are used to determine any deleterious constituents in the concrete and will give an evaluation of the concrete solids. This may also give the applicator warning of potential problems if certain constituents are present (or missing). This test is also recommended *for all* coating projects performed on older concrete of unknown usage.

4. **"EDXA" Energy Dispersive X-Ray:** Determines mineralogical composition of the concrete cap and is usually used in conjunction with the XRD above.

5. **"PETRO" Thin Section Petrographic Analysis**: (For ASR analysis). This test is usually performed on older concrete slabs to check for ASR (Alkali Silica Reaction) activity or where ASR may be suspected. ASR is not a common occurrence but has gained in numbers of infected projects both new and old. ASR used to be limited to certain areas primarily the southwest only and some areas of the Midwest and southeast. ASR is a reactive occurrence and is directly related to the type of aggregate used in the concrete. The ASR causing culprits are recognized as fossilized aggregates such as chert, fossilized rock and rock fragments, which are unique to these areas. Due to the increased transport and importation of various aggregates into the US, the ASR containing aggregate is showing up in all sections of the country.

In most cases the test sample for all these tests will be a drilled core sample using a dedicated core-drilling tool. Again, these core samples are usually 3" in diameter by 2", (called a 3 X 2). A 3 X 2 is the usual size required unless the lab or the conditions/technical staff requires a deeper core for further testing. As far as cost is concerned, the cost of performing these tests on 3 or 4 core samples is very small compared to all the possible costs involved in a coating failure down the road. Usually the facility owner will pay for these tests to be performed but, if not, this is a relatively inexpensive insurance policy that will go a long way to assuring a more successful job.

Independent Testing Labs:

Mineralogy, Inc. General Mineralogical/Analytical Lab; 3321 East 27th St., Tulsa, OK 74114; Phone: Phone: (Toll-free) 877-744-8284; tmurphy@mineralogy-inc.com Phone: (918) 744-8284; Fax: (918) 743-7460; Contact: Tim Murphy, Pres; Kris Murphy.
Braun Intertec Corp. General Mineralogical/Analytical Lab; 11001 Hampshire Ave S Minneapolis, MN 55438 Phone: (Toll free) 1-800-279-6100; www.braunintertec.com; Contact: Alfred Gardiner: Principal Engineer.
ETS, Environmental Technical Services: 975 Transport Way, Suite 2; Petaluma, CA 94954; Phone: (707) 778-9605; Fax: (707) 778-9612; Liquids analysis (blister water) Soil, water & Air Testing and Monitoring; Analytical Labs; Technical Support. Contact: G.S. Conrad.

These labs are independent and have proven to be very knowledgeable on concrete make-up, moisture and contamination issues from simple vapor and pH transmission to ASR and cellular level moisture/gel chemical activity of concrete and aggregates and organic contamination. These labs offer current ASTM[6] testing protocols, practices and procedures and offer the necessary lab testing that the installer/applicator may need to provide both preventive, (pro-active), and forensic, (after the fact), testing for present projects, future jobs or problems with an existing or past flooring projects.

[6] Refer to ASTM publication Significance of Tests and Properties of Concrete and concrete making materials, Publication STP 169C; ASTM Publication Code No (PCN) 04-169030-07 for more details.