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Wednesday , March 30, 2011

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Volume 1, Issue 4, February 2000

The Silent Crisis Beneath Your Feet

There's Another Source Of Moisture In Buildings That Very Few People Realize: Concrete Slab Foundation

In this photo, mold growth on the slab following the removal of the floor covering, which then is allowing the surface to dry out again.

Publisher's Note: Also contributing to this article, Patti Blackhall is the owner of Wild Spirit Consultants, a travel agency specializing in conducting real African safaris. Blackhall became a victim of mold contamination, and has since interacted nationally with many industry experts on the subject.

Imagine that you suddenly begin to lose your thoughts, mid-sentence. You are no longer able to remember the general gist of a conversation, and the logic of your sentences breaks down. Your hair falls out in clumps. You break out in rashes and welts that may last for weeks. Imagine excruciating fatigue that collapses you in your tracks. There is a "whole body weakness" which is frequently accompanied by muscle pain, nausea, dizziness, sinus infections and headaches. Something in your building is making you sick.

Anxiety turns into depression. You suffer from breathing difficulties, gastrointestinal distress, blood vessels breaking and vision impairment. Routine decisions become overwhelming and you feel like your life is falling apart. Imagine watching your bright, energetic child change before your eyes into a sickly youngster, unable to concentrate, who tires rapidly, and begins failing in school. Lives change quite suddenly and with no definable cause. Now imagine being one of the many parents, who has watched their infant suddenly die from bleeding in the lungs, as doctors helplessly look at them with no idea of the cause of this abrupt, horrible death… Something in the building did it.

Across America, more and more buildings are diagnosed with "sick building syndrome". This could be a result of a wide variety of problems from second-hand smoke, to

volatile organic compounds in construction products. However, at the top of the list, the most damaging problems that lead to the horrors described here, come from toxic mold growing inside the building envelope. Across the nation, more and more television broadcasts are seen about toxic mold. Some have even said that toxic mold invasion could become the "fourth wave" of construction defect litigation.

Mold or fungi, is a very interesting and competitive creature. When moisture is present in the right quantity and in the right conditions, mold will flourish. At first, there might be several hundred species all competing for the real estate and water sources. But in order to compete, fungi of various types produce proteins that are highly toxic to their competitors, as well as to human beings and animals. These "biological weapons" result in both allergic and toxicological illnesses in people.

Mold spores are living quietly in virtually every building and do not typically cause problems for people. Food sources can be found in most organic building products. What mold or fungi need to find most in a building, is moisture. At a relative humidity of 70 percent or greater, not necessarily in the room but against a construction product like drywall or carpet, mold can flourish to toxic levels. It only takes days.

Most considerations of building moisture sources are directed to flood damage, leaks in walls or roofing, or improperly specified or poorly serviced HVAC systems. While that is certainly enough, there is another source of moisture in buildings that very few people ever realize: The concrete slab foundation. The IAQ community talks about the time we spend indoors which is remarkably high, but what is also interesting is that most of us spend most of our lives on top of concrete slab foundations. Where are you right now? Chances are, there is concrete beneath your feet.

Moisture is a very critical constituent to healthy, hardened concrete. Without moisture, the hydration process of cement will cease and concrete can crumble and fall apart. Too much moisture in concrete, on the other hand, presents a problem for building interiors. Due to natural environmental activity, moisture emits from the concrete surface as a vapor or gas. Certainly there is a tremendous volume of water contained in a new slab. However, a 10-year-old foundation can still emit a large volume of moisture in the form of vapor, when underground moisture sources are fueling it.

Water vapor and the chemistry of concrete, has already created an enormous problem across the nation for floor

coverings. If slab moisture and pH conditions cause the flooring to fail, it results in the building user having to shut down operations and move out of the building in order to effect repairs. Typically this mechanical failure problem occurs in 6 to 18 months after occupancy, with the lawsuits being filed in much shorter time.

Homeowners to the Fortune 500, have experienced floor failures from slab moisture and alkalinity. Sometimes more than once! The mechanical failure of resilient floor products can be seen in many buildings. You just have to look down to the obvious. Tiles that peel off the floor, joints that are growing in size and bubbles in vinyl floors are clues. If you have ever had a floor failure or been financially involved, you will attest that it is an experience you will never forget.

However, there is a more serious side effect, one that is even less understood, costs more and hurts many. Biological growth flourishes, due to uncontrolled high humidity under floors. The photo of the carpet darkened with mold, was taken in the home of Patti Blackhall. The fungi growth was a result of a slab moisture condition that provided 100 percent humidity under the floor. The sustained moisture permitted the mold to grow to seriously toxic levels before it was discovered. The mold didn't show through to the surface. But when the carpet was pulled back it aerosolized particulate matter into the air, contaminating everything and everyone, permanently forcing Patti to vacate her home and abandon most of her belongings. In a normal abatement procedure, workers would set up extensive ventilation systems and use special suits and respirators. Nobody knew what was about to happen.

"For years, I've experienced the terror I asked you to imagine", Patty Blackhall says (portrayed in the introduction of this article). "I had to abandon my home in Tucson and leave everything in it. All my personal and sentimental things, as well as my business files and equipment, my whole life, was contaminated by mycotoxins released by a very dangerous mold called Stachybotrys chartarum. Like a number of others, I have learned, I have been a victim of a huge problem that few people are even remotely aware of." Her story is typical, like it is for countless unaware people nationwide.

Many across the United States have become sick, forced out of homes, schools and workplaces due to health problems related to molds like Stachybotrys. In many cases moisture sources are from wall & roof leaks, or plumbing or ventilation system problems. However, there are a growing number of cases where the concrete slab foundation was the primary source of sustained humidity.

According to the Carpet & Rug Institute of Dalton, Ga. (www.carpet-rug.org), the maximum tolerable moisture emission from concrete, should not exceed 5 pounds (by weight) of water per 1,000 square feet per day.

An emission of 8.3 pounds is equivalent to 1 gallon of water (per 1,000 square feet per day). Given that for math purposes, one can see how a large volume of moisture can be introduced in a building, over time. A building with poor air circulation and a high moisture vapor emission can result in a high-sustained humidity for the floor. The volume of pounds is not directly equated to relative humidity, for airflow is an intervening variable. Suffice it to say, there is not a great deal of humidity-evacuating airflow, in closed, sealed building envelopes like classrooms during breaks.

It is true that architects, engineers and contractors take measures to reduce moisture intrusion in concrete slabs by having a vapor barrier installed under the slab. However, few act as such and should be called "retarders" instead. When the vapor retarder is punctured, rotted away over time (biodegradable) or worse yet left out altogether, moisture can render a building with an ongoing slab problem for years to come, if the concrete allows moisture to pass, which is another variable. A vapor retarder does not eliminate problems, but it can minimize damage as it keeps ground moisture from intruding on a long-term basis.

A vapor retarder has no effect on the moisture conditions of new construction. Despite our desire to build buildings more quickly, concrete hasn't agreed to dry out any faster than it always has! In most construction areas it may take 6 months to a year for a slab to dry to an acceptable moisture level. At 70 degrees, 40 percent maximum RH and with a 15 mph breeze, concrete is believed to dry at a rate of 1 inch in thickness per month. Hence a 4-inch slab takes at least 4 months. But if the slab gets wet again, for instance because it was exposed to rain, the drying time can triple.

Modern buildings have yet another problem despite having the best concrete slab. They are energy-efficient. Concrete is the largest, coldest component of most structures and is likely to allow condensation to occur at the surface when humidity is not properly evacuated. Many new buildings do not easily evacuate humidity without the help of active HVAC systems. This means when schools, for instance, shut down HVAC during nights, weekends or over the summer, humidity levels can rise dramatically. This can result in saturation of construction products, especially the floor area since cool concrete temperatures with warm, wet envelope

conditions can allow dew point to occur.

All concrete slabs regardless of age, elevation or location emit some volume of moisture in a vapor form. In a 3,000 square foot building, it is not unusual to have over 3 gallons of water radiate into the envelope each day, in the form of vapor. While that is not a great deal of water in relationship to what building occupants produce by breathing, it is a lot of moisture when it becomes trapped at the floor line. In many cases of high slab moisture vapor emission, probes placed under the floor have shown 100 percent sustained relative humidity.

Moisture and concrete go hand-in-hand, but it is a combination of things that lead to the conditions ripe for mold growth. Some have claimed that mold or fungi will not grow on concrete due to its alkaline nature. But most concrete slabs are exposed to the atmosphere over time where chemical interactions will lower the surface pH to near neutral. The moisture vapor that rises out of concrete is quite pure, with a relatively neutral pH level, and it may stay that way if moisture is allowed to evacuate. When trapped, like under a resilient floor, the condensed moisture can become alkaline, solving a problem for mold growth, but creating a new problem with floor material bond integrity.

Slab moisture can come into contact with organic debris from construction, such as dry wall dust and paint particles that are typically splashed onto slabs and buried under floors. The floor products themselves, such as adhesives and carpet padding can offer organic food sources for mold. Even those carpets with synthetic backings still contain a great amount of organic debris, when carpet systems are poorly maintained.

A topical seal on the slab can dramatically reduce the problem of concrete moisture with floors, providing it is engineered and installed properly. Sealing the "negative side" of the concrete, where moisture is escaping from and where moisture is accumulating, is a relatively new and challenging trade that is much more process-specific than product-specific. Many large companies have tried and failed to solve this problem long-term by producing a product, but it seems process control is far more critical, so topical slab moisture control has become a specialty industry.

The major problem is that in the scope of construction, the moisture emission rate of the slab is seldom even considered until the 11th hour. Here is how the crisis unfolds. The building construction is nearly complete. The flooring contractor comes to the job to install flooring. A licensed contractor has to follow manufacturer and

industry specifications, so the conscientious contractor runs a slab moisture test. If the results show that the moisture level (and/or pH factor) is far higher than the maximum tolerance for any kind of floor products, they must not install the floor or risk total liability in the event of failure. Since almost everything that goes into a building resides on the floor, not installing the floor on time can lead to very serious scheduling problems in completing the building for tenant move in.

In most cases the slab moisture issue leads to controversy as to who is going to be liable for a problem later. The floor contractor is following specifications to avoid failure, but can't control job conditions. The general contractor must build the best possible building, with the least amount of money and in the shortest period of time. Such a feat is remarkable, but not even a general contractor can hurry up Mother Nature. If the slab will not dry in time for the owner's schedule, the architect can specify a topical slab treatment be performed to solve the problem, as long as they are aware of this phenomena, and more importantly, if the owner will even pay for it.

The same scenario unfolds in remodeled buildings. Due to government legislation on volatile organic compounds, floors of a decade ago were made and installed with different materials than are on the market today. Moisture and pH conditions of slabs must be carefully considered before the installation of a modern floor, even if the old system never had a problem. Too many people have become victim of a floor failure simply because they never considered the possibility.

Most owners are made aware of these problems when the floor contractor (or somebody else) runs moisture tests prior to floor installation. Telling an owner at this point of construction, that more money will be needed to solve a problem they already don't understand, can't afford, and don't have time in the schedule to deal with, will generate frustration. Throw in the liability factor about mold growth, and it's a panic.

The architect might get blamed for "being ignorant". The general might get blamed for making "bad concrete". And the flooring contractor might get blamed basically because the failure of the product is what identified the problem slab condition. The floor covering community has nothing to do with concrete slab conditions. They exist prior to installation, but the floor covering community is often the ones who must test for them, else accept liability for failure or upset the general contractor, architect and owner with the "bad news" about the slab tests. The social implications of floor failure, then becomes far more an issue than the physics of it.

Concrete can be made compliant, obviously not all floors fail. But the solution starts with understanding what to do before the 11th hour.

Sadly, in most cases, the owner "signs off" on the problem out of ignorance, or entertains an ineffective solution, only to be a victim months later when the floor fails and/or a biological crisis occurs. People all over the nation have suffered extreme financial damages over this intriguing act of concrete building foundations. Floor failure is not singularly the fault of the concrete industry, the design community, the construction parties or the floor covering community. It is simply an environmental incompatibility between construction products coupled with budget constraints and time schedules.

The problem is fixable by a proper interface seal on the top of the slab, or by dramatic changes in design and placement of the concrete slab in conjunction with the rethinking of construction schedules. It seems ironic, but in many cases the building envelope is not acclimated until after finishes have been installed, so nobody knows if the moisture problem will occur, but they say "that's how its done". Yet almost all of these problems could have been prevented. Education and awareness, like in anything else, are required to make changes. However, it takes time to learn and time to react to new things. Awareness is growing about this problem as well as the health risks involved with damp buildings. Moisture intrusion from concrete is a problem in certain situations, but any moisture problems in buildings must be controlled since it accounts for most of the litigation cases in construction.

The next time you see a floor with oozing adhesive between the joints, tiles that lift and curl, rubber floors and polymer coatings that bubble, and carpeting that gets damp, you will know moisture is present beneath your feet.

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