Sweating Slab Syndrome

Editor's Note: Concrete Surfaces welcomes Peter Craig as a regular contributing editor for Problem Clinic. Craig in an independent concrete floor consultant with the firm Concrete Constructives. He has more than 34 years of experience with concrete slabs and specializes in diagnosing and correcting moisture-related flooring problems.

Craig has been involved with more than 200 moisture-related flooring issues nationwide and he lectures frequently on the subject. He is a member of ACI Committee 302 and served as national president of the International Concrete Repair Institute. He is immediate past co-chairman of the Moisture Task Group of ACI committees 302 and 360 and is a member of ASTM, responsible for several moisture-related standards.

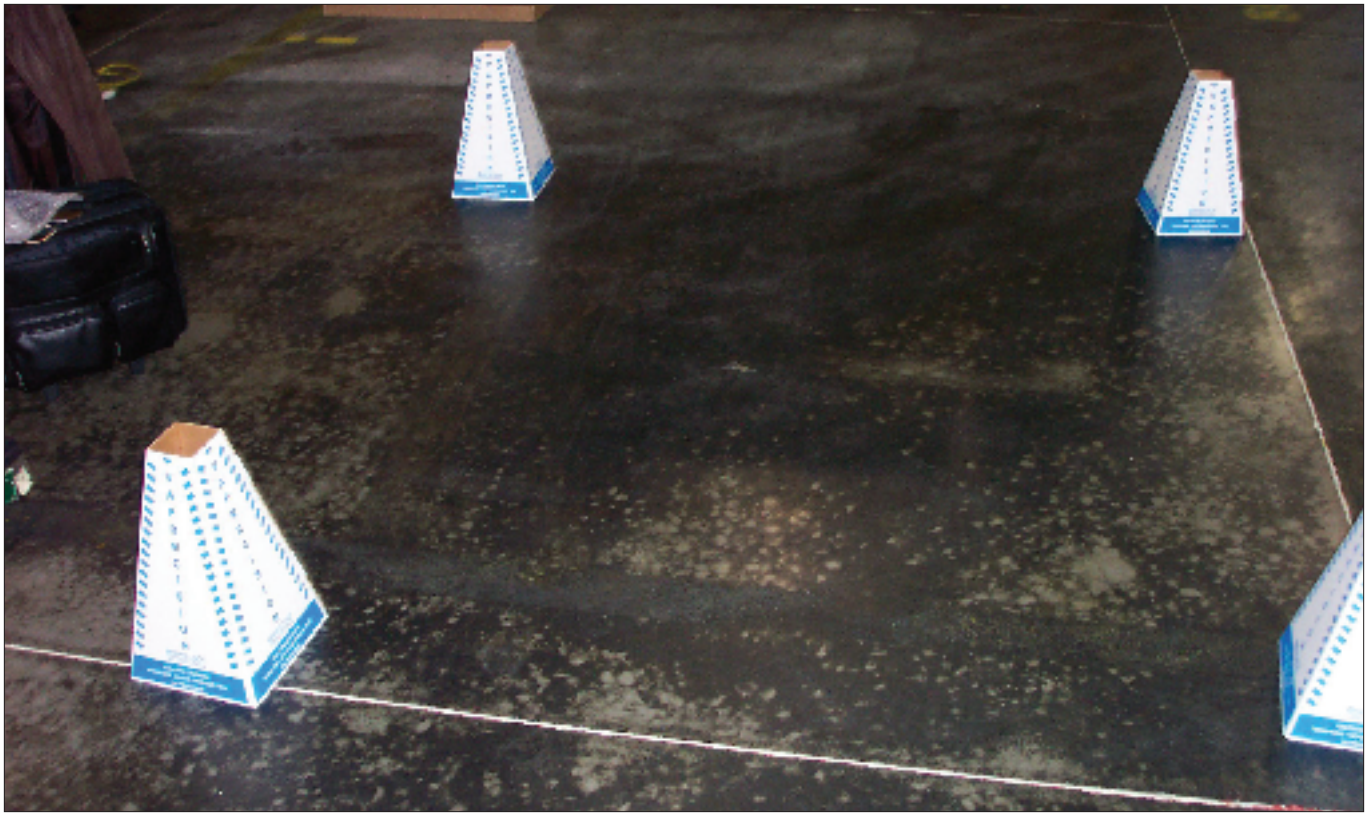
Q One of our clients owns a number of big box warehouses and has a problem with moisture periodically developing on the surface of the concrete floor slabs we placed about a year ago. We suspect this condensation forms in part because this portion of the building has no climate controls and very poor circulation of air. The client has had several serious incidents where their transport equipment has slid across the floor, damaging product and putting their workers' safety at risk.

At first they tried to blame us for our work. But an expert with whom I recently spoke suggested that their issue could very well be sweating slab syndrome. What is this and how can it be prevented?

A The diagnosis you received sounds correct. Sweating slab syndrome (SSS) is a phenomenon where moisture intermittently develops on the surface of an interior concrete slab. SSS can increase the slipperiness of the concrete surface and pose a serious risk to the safety of workers and material transport operations.

In one reported case of SSS, a loaded fork truck was unable to stop and slid off a loading dock onto the exterior pavement and into the path of an oncoming trailer. In many cases, stored product has been damaged or destroyed by sliding transport equipment.

SSS is a serious and often challenging phenomenon to diagnose and correct.



PETER CRAIG

Sweating slab syndrome is a condition where moisture develops on the surface of an interior concrete slab.

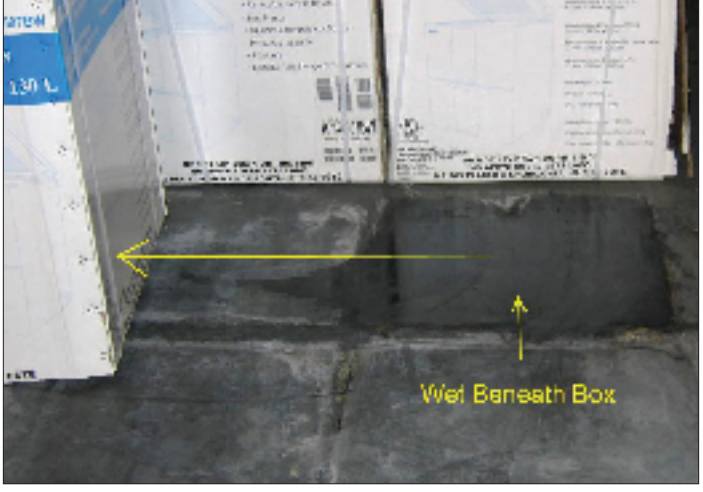
Solutions, however, do exist once the actual cause or causes are determined.

As you suspected, it is most often experienced in non-climate-controlled big box warehouses. In some parts of the country, schools have also experienced moisture developing on floor surfaces when HVAC systems are shut down during summer.

Q What causes sweating slab syndrome?

A Moisture is the underlying cause of sweating slab syndrome. However, there are a number of factors that alone or in combination lead to these events occurring. The classic cause of moisture developing on an interior concrete slab surface is dew point condensation. In these cases, warm, humid air enters the structure through open doorways, windows, and vents. As the warm, humid air diffuses throughout the structure, it will condense on any surface that is at or below dew point temperature, which is often the floor surface.

Slab condensation events most often occur with a rapid increase in ambient temperature and relative humidity. When warm, humid air enters a structure, it takes far less time to change the interior air temperature than it does the temperature of the slab. With such a rapid change in conditions, the slab temperature can easily be found at or below dew point. For example, ambient conditions within a structure have been in the range of 70º F and 50% relative humidity for several weeks, and the slab surface temperature is also close to 70º F. A weather front moves in with 80º F air and 90% relative humidity. As the warmer, moisture-laden air makes its way into the building, any surface that is at or below 77º F will be at dew point.



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Moisture emitting from within the concrete was trapped beneath boxes. Soluble salts within the concrete rose to the surface and were transported well beyond the immediate area by material handling equipment.

At dew point, moisture from the air will condense on any surface where it is not readily absorbed, including glass, steel, floor coverings, coatings or a tight, hard steel troweled or densified concrete surface.

Q Other than dew point, what can cause a slab to sweat?

A On some projects, salt deposits on the surface of the slab led to SSS. Here, the hygroscopic nature of the salt attracted moisture from the air and also possibly from within the concrete.

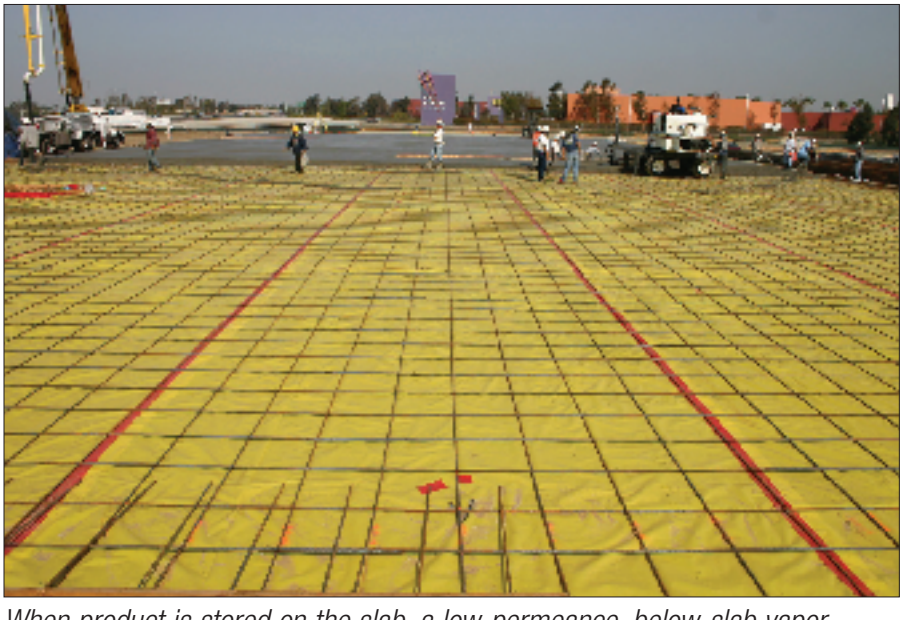
The salts came from within the concrete itself. No vapor retarder was present beneath the slab, and the finished product was stored in boxes stacked directly on the floor. Moisture emitting from within the concrete and transmitting upward from below was trapped beneath the boxes and reached a high enough level for soluble salts within the concrete to enter into solution and rise to the surface of the slab. As the boxes were moved, the salt solution or deposits were picked up by the wheels of material handling equipment and transported well beyond the immediate area.

Q Are there any other contributing factors?

A The density of the slab surface is a factor in SSS. It is not uncommon to observe that during slab sweating events, the pourback strips inside the perimeter of tilt-wall buildings do not sweat along with the main body of the slab.

When tested, the porosity of a pourback strip is generally found to be greater than that of the main floor. The most likely reason is that pourback strips are often not finished in the same fashion as the main floor and may not have received any sealer/densifier treatment that was used on the main body of the slab.

Q Are you suggesting that liquid surface densifiers may play a role in SSS?



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When product is stored on the slab, a low-permeance, below-slab vapor retarder can help reduce moisture from migrating upward and condense beneath the stored product.

A In one sense the answer is yes. Liquid surface densifiers have gained great popularity over the past decade. These typically silicate-based treatments can enhance the appearance and performance of a concrete slab surface. However densifying a concrete surface does, to a degree, further reduce surface porosity, which can increase the risk for slab sweating events to occur.

On the positive side, liquid surface densifiers are treatments that, when applied properly, react with soluble salts within the concrete surface region, reducing the availability of salts to attract moisture.

Researchers are still undecided as to whether unreacted sealer/densifier treatments play any other type of chemical role in SSS. More study is needed.

Q Any other potential contributors?

A The cleanliness of the slab is another potential contributing factor. A slab surface covered with black rubber tire marks or exhaust deposits can also reduce surface permeability. As a slab surface becomes less permeable, not only will it become less absorptive to moisture from above, but if an effective vapor retarder is not in place beneath the slab, moisture levels within the concrete and near the slab surface will increase over time.

Q What can be done to avoid sweating slab syndrome?

A The first step is to establish good housekeeping practices that remove any type of deposits from the surface of the slab. Commercially available cleaning agents can be used in floor scrubbing and vacuuming machines.

The next step is to examine air movement within the building. Many big box facilities provide little air movement and may exhaust interior air through roof vents, creating negative pressure in the building. Negative pressure within a structure quickly allows exterior air and other conditions to enter the building when loading dock doors are open.

Large ceiling fans can help reduce or eliminate slab sweating by minimizing ceiling-to-floor temperature differentials and increasing the surface evaporation rate. In addition, commercial dehumidification units can alter the interior building environment to help reduce or eliminate SSS.

For facilities where product will be stored directly on the slab, a low-permeance, below-slab vapor retarder can help reduce the potential for moisture to migrate upward and condense beneath stored product.

Peter Craig can be reached at 207-946-5697, or e-mail pcfloors@msn.com.