No Sand Please !

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For many years the issue of vapor retarder location beneath concrete slabs-on-ground had been one of debate and controversy. On the design side there was the recognized need, and requirement to provide protection to flooring materials from moisture originating from the ground. On the concrete side there were however a number of concerns regarding the behavior of concrete placed in direct contact with a vapor retarder material.

Today, despite there being several valid concerns about placing a slab directly over a vapor retarder, both the flooring industry and the concrete industry have reached agreement that when a moisture-sensitive material is to be installed over a concrete slab on or below grade, the vapor retarder material must be in direct contact with the underside of the slab.

With both ACI and ASTM publications now citing this requirement it would not be wise for a designer, general contractor or concrete contractor to not follow the latest industry requirements and thus expose themselves to liability for a flooring failure that is the result of moisture transmission from the ground.

Why Directly Below ?

The idea of sandwiching a layer of granular fill between the vapor retarder and the underside of the slab came about from the desire to satisfy the need to protect flooring materials from the potentially adverse affects of moisture rising from the ground while having the concrete behave as if the vapor retarder were not there. At first it seemed like a good idea and ACI 302.1R-96 included the following statement:

> **4.1.5** *Vapor barrier/vapor retarder*—If a vapor barrier or vapor retarder is required due to local conditions, these products should be placed under a minimum of 4 in. (100 mm) of trimable, compactible, granular fill *(not sand)*. A so-called "crusher run" material, usually graded from $1^1/_2$ in. to 2 in. (38 mm to 50 mm) down to rock dust, is suitable. Following compaction, the surface can be choked off with a fine-grade material (Section 4.1.4) to reduce friction between the base material and the slab.

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Gradually reports began to surface about moisture-related flooring failures occurring on projects where the fill course / blotter layer had been used. In some cases it turned out that the fill course had taken on a considerable amount of water from rainfall prior to, or during the slab placement. In other cases it was determined that tears, punctures or improperly sealed penetrations had provided an avenue for moisture to enter the fill course and travel freely beneath the slab which over time increased the moisture level within the slab.

In 1998 an ACI Moisture Task Group was formed to report back to ACI Committee's 302 (Slab Construction) and 360 (Slab Design) on flooring failures that were found to be directly linked to the use of the granular layer. As a result of the task group's work, an update on vapor retarder location was published in the April 2001 edition of Concrete International. A copy of this update is included in **Appendix A.** This update was accompanied by a flow chart to help guide the decision making process. The original flow chart is also included in **Appendix A.**

In the years that followed wording from the update and the flow chart were incorporated in ACI 302.1R-04 and ACI 360R-06. In 2006 ACI also published ACI 302.2R-06 which is a comprehensive guide for concrete slabs that receive moisture-sensitive flooring materials. All of these documents included the original vapor retarder location decision guiding flow chart.

In 2008, ASTM F710; "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring" incorporated the following requirement:

4. General Guidelines

4.1 The installation of a permanent, effective moisture vapor retarder with a minimum thickness of 0.010 in. and a permeance of 0.1 y, as described in Specification E 1745 is required under all on- or below-grade concrete floors. The use of such a moisture vapor retarder, provided its integrity has not been compromised, reduces potential severity of water vapor penetration. Every concrete floor slab on- or below-grade to receive resilient flooring shall have a water vapor retarder (often improperly called a vapor barrier) installed directly below the slab.

Sand layer taking on water from rainfall

Flooring failures on project above

Even the State of California, which was one of the last areas of the country where some contractors continued the practice of putting a granular fill material over the vapor retarder has recognized the importance of having the vapor retarder directly below the slab.

SECTION 4.505
INTERIOR MOISTURE CONTROL

4.505.1 General. Buildings shall meet or exceed the provisions of the *California Building Standards Code*.

4.505.2 Concrete slab foundations. Concrete slab foundations required to have a vapor retarder by *California Building Code*, CCR, Title 24, Part 2, Chapter 19, shall also comply with this section.

4.505.2.1 Capillary break. A capillary break shall be installed in compliance with at least one of the following:

1. A 4-inch (101.6 mm) thick base of $^1/_2$ inch (12.7 mm) or larger clean aggregate shall be provided with a vapor barrier in direct contact with concrete and a concrete mix design, which will address bleeding, shrinkage, and curling, shall be used. For additional information, see American Concrete Institute, ACI 302.2R-06.

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In 2015, ACI Committee 302 published an update to the original vapor retarder location flow chart to further emphasize the need for the vapor retarder to be placed directly below the slab when moisture sensitive materials are to be installed or moisture-sensitive product is stored directly on the slab.

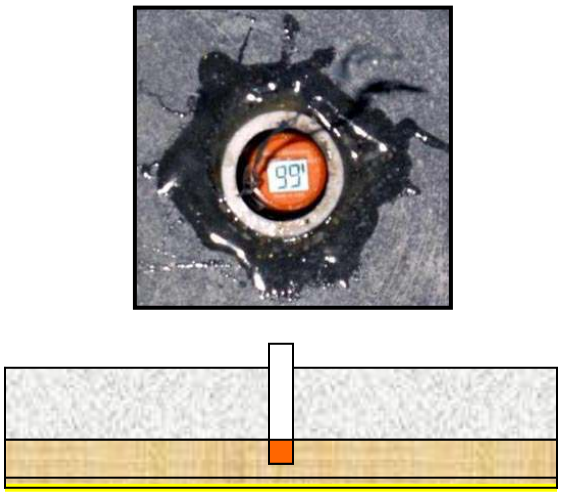
A copy of the latest flow chart is included in **Appendix B.**

Summary:

Like so many other things in life, valuable lessons are learned from mistakes. While it has taken many years to settle the issue of vapor retarder location, both the flooring industry and the concrete industry today accept, and recognize that for a below-slab vapor retarder to be effective it must be in direct contact with the underside of the slab.

With the vapor retarder in direct contact with the underside of the slab, any tear or puncture limits the potentially damaging influence of moisture to but a very few inches of the slab. However when the vapor retarder is placed below a layer of granular fill, moisture entering through a tear, puncture or improperly sealed penetration has an avenue to migrate throughout the fill course and increase the moisture level within the entire slab.

The following photograph and diagram illustrate a relative humidity measurement taken in a 2" layer of sand placed over the vapor retarder on a troubled project in California.



RH test in sand layer above vapor retarder

Often change does not come easy and such has been the case with the 180 degree turn from previous directives. The change however was needed and today it is no longer optional as to where the vapor retarder is to be placed when a moisture-sensitive flooring material or product is involved.

So what does the reluctant concrete contactor do to minimize the potentially adverse affects of placing concrete directly over a vapor retarder ?

1. Use a low-shrinkage concrete mixture that is not overwatered.

2. Isolate any object or re-entrant corner that would provide restraint to concrete drying shrinkage.

3. Use a surface evaporation retardant to help minimize rapid moisture loss from the slab surface after strikeoff and if necessary throughout the finishing process.

4. If sawcut control joints are specified, use early entry methods to make the cuts as soon as possible after final finish.

5. Accept that it will take a bit longer for the concrete to reach a state where it can be finished.

6. Use properly sized and spaced reinforcing steel to help minimize slab curl and the potential development of dominant joints.

7. Begin the curing process immediately following final finish or sawcutting.

Despite the pushback by some contractors over the years the truth is that concrete slabs are being placed successfully directly over vapor retarders every day from coast to coast.

With a low-shrinkage concrete mixture, proper detailing and good concrete practice all of the concrete concerns can be overcome at a cost many, many times lower than having to deal with facing liability for moisture-related flooring failure

END