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Myth:

An under-slab vapor retarder/barrier isn't necessary in dry climates.

Facts:

It is all too easy for those who design and construct buildings in very dry regions of the country to not give moisture from the ground the consideration it deserves. Cities such as Phoenix, Arizona, Las Vegas, Nevada and Albuquerque, New Mexico each receive on average less than 10 inches of rain per year. They also have water tables well below the surface of the earth. How can there possibly be a need to protect a concrete slab-on-ground from the entrance of moisture from below?

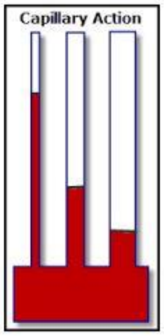
For the answer, we first turn to science and a report issued by the Building Research Advisory Board (BRAB) in Publication 596 of The National Academy of Sciences (NAC). In section 6.0 of the publication the committee states their belief that regardless of the depth of the water table, or the amount or frequency of precipitation, it is likely that 100% relative humidity exists beneath concrete slabs-on-ground even under favorable soil and drainage conditions.

In support of the committee's belief is the evidence that, since it's publication, numerous floor failure investigations conducted by respected firms have measured the relative humidity (RH) in the ground beneath concrete slabs to be at, or close to 100%.

Now, no one would question 100% RH in the ground beneath a slab in Florida where the water table may be only 6 feet below the slab. But in Albuquerque, New Mexico— where the water table can be over 1,000 feet below the surface of the ground— how can this be?

Again, we turn to science to understand the upward migration of moisture in soils. There are two basic means by which moisture in the ground can rise from the water table to a higher elevation: capillary action and diffusion.

As it relates to our discussion, capillary action is the rise of water in liquid state to an elevation higher in the ground than the water table. For this to occur, the interstitial space (gap) between soil particles must be extremely small such that the adhesive attraction of water molecules to the soil particles forming the narrow passageways exceeds their cohesive strength. The combination of adhesive attraction, surface tension and the cohesive strength of water can cause liquid water to rise many feet above the measured water table if the soil conditions are favorable to capillary rise.



The potential rise of water in soils by capillary action is well known and understood by those in the geotechnical field. When such a condition exists or is of concern, the typical solution is to remove (to a specified depth) the finer soil material and replace it with a coarse fill material (such as crushed stone) where the gap between particles is relatively wide and not conducive to the capillary rise of liquid water. In the drier regions of the country, where the water table is well below the surface of the earth, capillary action is seldom the cause of moisture-related flooring or coating problems.

The second means by which moisture rises from the water table to a higher elevation is diffusion. Diffusion is a well-established scientific principle where molecules move from an area of higher concentration to and area of lower concentration until a state of equilibrium is reached. As it relates to our discussion, in the ground, regardless of the depth of the water table, water will undergo a phase change from a liquid to a vapor and the vapor will rise upward by diffusion through the soil structure in an attempt to establish a state of equilibrium with the drier environment above (i.e. within the building envelope).

In arid regions of the country, rising water vapor evaporates so quickly into the dry air above the earth that one can easily be convinced that moisture will not be a problem to a structure built in such a climate and over a water table that sits well below the surface of the earth. However, once a concrete slab is placed on the ground, the free evaporation of rising water vapor is restricted. Gradually, the relative humidity in the soil structure directly below the slab will increase and reach 100% as believed by the Building Research Advisory Board and as confirmed by numerous in-situ studies by respected consultants and forensic engineering firms around the country.

No problems with moisture in the desert? Please think again. In the past several years, I have investigated or been made aware of over a half-dozen serious moisture-related flooring issues in the Phoenix area alone.

In closing, even if you were not to believe a word of this Myth Buster, please be advised that, today, the use of an ASTM E1745-compliant vapor retarder material, placed directly beneath the concrete, is not optional. ASTM F710 and most floor covering manufacturers now require that a low-permeance below-slab vapor retarder be installed directly in contact with the underside of the slab when any type of resilient floor covering material is being installed. ACI 302.1R and ACI 302.2R now provide similar guidance and go one step further, recommending that, in addition to floors that will receive moisture-sensitive flooring materials, a low-permeance vapor retarder be installed directly below bare concrete slab surfaces, such as warehouse slabs, where moisture-sensitive product is to be stored in direct contact with the slab surface.

Don't need a vapor barrier in the desert?

Please think again. . .

Photo from flooring failure in Bakersfield, CA.
Bakersfield is one of the driest cities in CA averaging only 6.45 inches of rain annually