A Conversation about Vapor Barriers in Durisol Building

Participants:

Bruce Coldham	Architect	Coldham & Hartman
Terry Brennan	Building Scientist, Researcher	Camroden
Marc Rosenbaum, P.E.		Energysmiths
John Straube	Building Envelope Engineer	University of Waterloo

Bruce to Terry:

Terry,
I am sending you a couple of samples of Durisol "to see if you can grow anything in it".
Marc was counseling me against having some vapor barrier (waterproofing) on the outside of the wall that would be a condensing surface for moisture arriving from the interior. I thought that, since the Durisol (I think) is not a food material, nothing evil would grow there even with water around.
Bruce

Marc to Terry and John:

Terry and John,
OK, I'm still confused (what else is new?) about how the inside and outside of Durisol should be finished below grade. I checked the humidity ratio of saturated 40F air (my pick for soil temperature) and it is equal to 60F air at 50% RH. So my sense is that most basement spaces will be more humid than this and therefore will have a higher vapor pressure than outside in the soil.
Assuming the inside is parged but not painted, doesn't it make sense to put a vapor permeable coating on the exterior parging? You seemed to agree at the conference that a vapor retarder was the right solution but I don't understand why there isn't the potential for moisture accumulation on the inside of the exterior skin of the Durisol. Most of the time it would seem that if the basement air is near saturation the soil temperature will be below the dewpoint of the interior air.

Isn't this a somewhat analogous situation to some of the straw bale homes with

moisture sensors in the walls that showed moisture accumulation at the bottom adjacent to the inside face of the exterior?

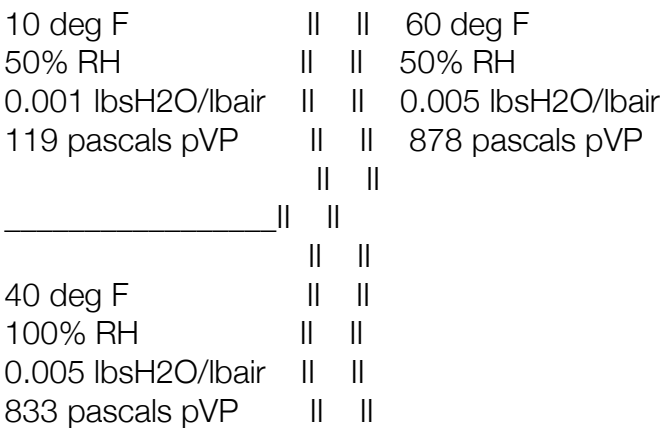
Enlightenment sought, please...
Marc

Terry to everybody:

I've been wetting and drying a Durisol sample for several days - no sign of fungal growth yet.

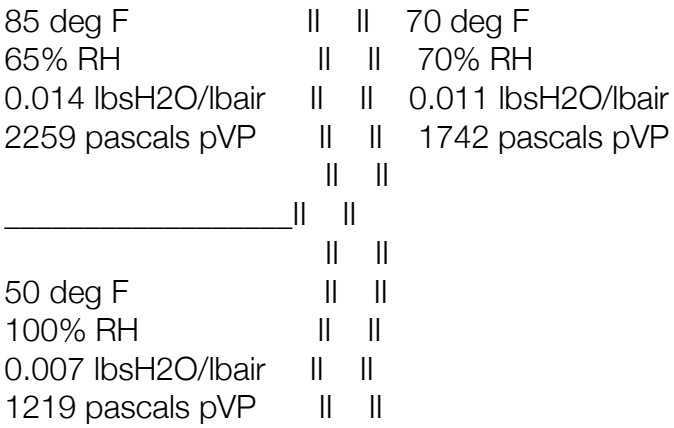
Here are my thoughts on the water vapor dynamics of Durisol foundations. The wall has an inner and outer leaf of wooden/portland matrix that is highly water vapor permeable and has quite a lot of moisture storage capacity in the adsorbed state. It has a core of concrete that is vapor permeable, but far less so than the inner and outer leaves.

When it is cold and miserable outside we have something like these conditions:



Water vapor will be trying to get to the outdoor air from the soil and exterior leaf from outdoor air and from the basement air. In this case a below grade impermeable membrane poses no problem. The basement would need to be substantially more humidified than this for there to be a problem because the outer leaf allows water vapor to pass through the above grade portion of wall to the outside. I see no problems for wintertime conditions with parge coat above grade and damp proofing below.

However, when it is hot and miserable outside we have something like these conditions:



Water vapor will be trying to get to the below grade exterior leaf from outdoor air and from the basement air. The outdoor air will dominate the moisture migration because of the vp difference and the permeability of the outer leaf. This is the time when there is most likely to be condensation within the outer leaf if there is an impermeable membrane below grade. However, even in this situation I guess that Durisol has enough vapor capacity to handle the situation without problems (Durisol is so vapor permeable that a large portion of the exterior leaf will be effective storage).

It would be interesting to do a two-dimensional vapor flow analysis on a section. Might be able to do it with the research version of wufi. it can certainly be done with latenite. let's talk to John Straube about it.

Terry

Marc to Terry:

Thanks for your thoughts.
1 - you wrote "Water vapor will be trying to get to the outdoor air from the soil and exterior leaf from outdoor air and from the basement air.." I don't understand this sentence. What do you mean by "exterior leaf from outdoor air"?

2 - I expect that the basement is much closer to saturation than you've assumed. Does that change your thinking? Are you putting your money on the fact that the Durisol is so permeable vertically that it can dry to the outside even if there is condensation at the interior of the impermeable membrane on the exterior of the foundation wall? Because this surface will be below the dewpoint of the basement air probably year-round, yes?

Marc

John to Marc and Terry:

Hi Guys
No time to do any real numbers, but a few comments
1. you might get mold growth on Durisol if you coat it with bakers sugar and agar and leave it sit on your desk in contact with liquid water. Of course, this is not the Durisol getting moldy but the food you added

2. The basement analysis. Marc's soil temp assumption of 40 F is way too low. The attached Word file shows the soil temp vs depth and time for Minneapolis and Toronto (sorry -- this was the closest info I had on my hard drive). I drew in a line at 40 f (=5 C). Most of the year at most heights of the basement, the temp is well above 40 F. I would also add the most cold climate housing has a interior dew point temperature of more about 40 F or lower in the coldest months. The temps I show are WELL AWAY from buildings. The temperatures in the vicinity of a basement will be higher in the winter, by about 2 to 4 C because of the heat loss from the basement. Hence, the soil temps in the plots can be bumped upward in cold weather.

3. I dont think vertical permeability to vapor is a drying path of any real note since 2 ft of vertical Durisol is pretty vapor impermeable. The reality is that the annual average vapor drive is from the exterior to the interior, and that the storage capacity and vapor resistance of the Durisol are both high enough to store any high RH conditions in the winter for drying in the summer. The use of a low permeance membrane on the exterior will ensure that the soil does not act as a moisture source.