Water Vapor Transmission DS159

With the advent of modern, airtight, highly insulated buildings, it has become increasingly important to consider vapor flow characteristics when designing exterior walls. Condensation was rarely a problem in older buildings because they had such high air-exchange rates just from air leakage that water vapor essentially traveled freely through the walls without ever reaching pressures that would result in condensation.

The need for vapor retarders and their proper location within a wall assembly is influenced by the interior and exterior environmental conditions as well as the wall's thermal and vapor flow characteristics.

Generally speaking, buildings in cold northern climates will benefit from having a vapor retarder installed near the interior side of the wall while buildings in warm, humid climates generally need to avoid low permeance materials at those locations.

It is important to note that each building is fairly unique in terms of wall construction, interior usage and environmental conditions and should be evaluated individually by the building designer.
The measure of the amount of water vapor in the air is known as relative humidity (RH) and is stated as a percentage. At 100% RH, air contains the maximum amount of vapor it can hold, and such air is said to be saturated. The temperature at which saturation occurs is called the dew point temperature.

The concentration of water vapor may also be stated by giving its pressure, commonly expressed in inches of mercury (in. Hg).

Water vapor establishes a pressure proportional to the amount of water vapor present within the air mix. Air with more vapor has a higher vapor pressure. At a particular temperature and at saturation, the water vapor exerts a definite pressure (Vapor Pressure at Saturation).

When a vapor-pressure differential exists, water vapor will move toward the lower pressure independently of air. For instance, with a winter condition of 0 °F and 75% RH, an outside vapor pressure of 0.027 in. Hg would exist, while inside a building heated to 70 °F and with 35% relative humidity, vapor pressure would equal 0.259 in. Hg. The vapor pressure inside would be nearly 10 times as high as outside. Like other gases, water vapor moves from an area of high pressure to an area of low pressure until equilibrium is established. During cold weather, the difference in pressure between inside and outside causes vapor to move out through every available crack and directly through many materials that are permeable to water vapor. When vapor passes through pores of homogeneous walls, which are warm on one side and cold on the other, it may reach its dew point and condense into water within the wall. In warm, humid climates, the flow of water vapor will be reversed and flow from the outside to the inside. Under such circumstances, it is necessary to avoid use of interior wall coverings, i.e., vinyl wallpaper, which have low permeance to water vapor.

Dryvit Systems, Inc. offers a Water Vapor Transmission (WVT) analysis at no cost to the customer to determine the potential for condensation in a specific wall. A Water Vapor Transmission Request can be submitted to Dryvit with appropriate information. The WVT analysis will be returned using the format on the enclosed sample.

The actual vapor pressure is compared to the saturation vapor pressure at each point in the wall. If actual vapor pressure is less than the saturation vapor pressure, no condensation occurs. Conversely, if actual vapor pressure is more than the saturation pressure, the potential for condensation exists. It still must be decided whether the condensation rate is serious, since it might readily be evaporated during the condensation period without excessive wetting.
The amount and rate of water vapor transmitted through building materials is dependent on: (1) the gradient (differential) in vapor pressure from one side of the material to the other, (2) the area of the material and (3) its permeance (ability to permeate vapor passage).

A good rule of thumb to insure safe outward diffusion of vapor is that the combination of exterior materials should have a total installed permeance of at least five times the total permeance of the interior vapor barrier plus interior finish materials.

Water vapor permeance is a measure of water vapor flow through a material of specific thickness, or an assembly of several materials. The reciprocal of permeance is called vapor resistance.

Water vapor permeability is the permeance of a 1 inch thickness of a homogeneous substance.

perm:
: The unit of permeance which states the amount of vapor flow in grains per hour, per square foot of surface, per 1 in. Hg. vapor pressure gradient.

perm inches:
: Designation for permeability stating the amount of vapor flow through 1 inch of material, in grains per hour, per square foot of surface, per 1 in. Hg. vapor pressure gradient

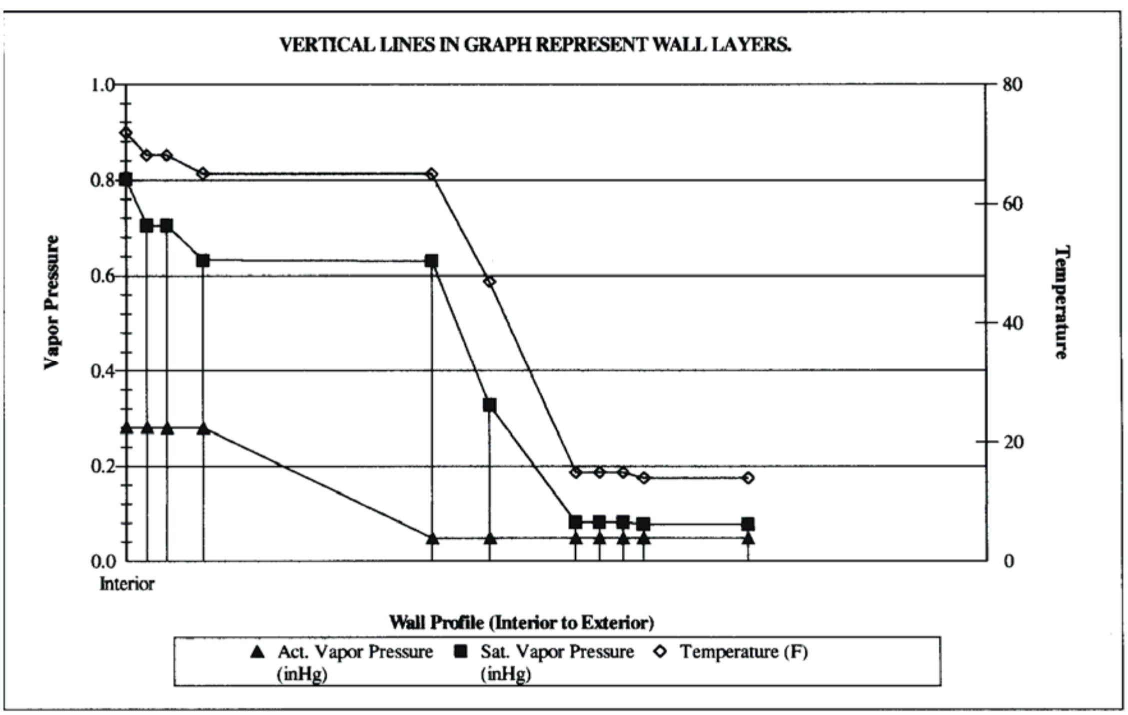
Materials which have a permeance (perm rating) of 1 perm or less are referred to as vapor barriers.
One of the reasons for using 1 pcf density expanded polystyrene is that it has the highest permeance of any of the cellular plastics. It does not create a vapor barrier on the exterior of the wall. The requirements for vapor barriers with Dryvit EIFS are not unusual. It is good practice to be aware of unusual design conditions associated with particular building functions or climatic regions and do a water vapor transmission analysis if there is a legitimate question.

Sample Water Vapor Transmission Analysis

Project: ABC Building
Location: City State
Condition: Winter
Date: 5/7/97

Interior Temp. (F): 72
Interior R.H. (%): 35
Exterior Temp. (F): 5
Exterior R.H. (%): 67

Material	Thickness (in.)	Therm Res (h ft^2 f/Btu)	Moist Res (inHg ft^2 h/gr)	Temp (F)	Saturation Vapor Pressure (inHg)	Actual Vapor Pressure (inHg)	Cond Rate (gr/h ft^2)
Interior				72.0	0.8020	0.2807	
Inside Air Film Non-Ref (Still Air)	0.01	0.68	0.001	69.8	0.7442	0.2806	
Latex Paint 2 Coats	0.002	0	0.3	69.8	0.7442	0.2443	
Latex Primer	0.0012	0	0.16	69.8	0.7442	0.2250	
Gypsum Wall Board - 2	0.5	0.45	0.027	68.3	0.7069	0.2217	
Kraft Paper Facer	0.01	0	1	68.3	0.7069	0.1008	
Fiberglass Batts - unfaced - 2	3.5	11	0.028	32.5	0.1864	0.0974	
Dens Glass Gold - 1	0.5	0.56	0.029	30.7	0.1718	0.0939	
Polystyrene, Expanded (1.0PCF)	2	7.7	0.4	05.6	0.0508	0.0455	
Primus Base Coat	0.063	0	0.038	05.6	0.0508	0.0409	
Sandpebble-DPR Finish	0.06	0	0.065	05.6	0.0508	0.0331	
Outside Air Film Winter (15MPH)	0.01	0.17	0.001	05.0	0.0492	0.0330	
Exterior				5.0	0.0492	0.0330	
Total:	6.6562	20.56	2.049				



WATER VAPOR TRANSMISSION REQUEST FORM

Please type necessary information in the table below, print and fax to IJ Valainis, Engineering Department, (401) 823-8820.

Project Name	
Project Location	
Firm Name	
Contact Person	
Address	
Zip/Postal Code	
Country	
Phone No.	
FAX	
E-mail	
Distributor/Sales Rep	
Date Needed By	
Notes	
Interior Design Temp. °F	_____Summer _____Winter
Interior Relative Humidity %	_____Summer _____Winter
Exterior Design Temp. °F	_____Summer _____Winter
Exterior Relative Humidity %	_____Summer _____Winter
Wall Construction:	**List all materials, including paints, from the interior surface to the exterior surface.**
<u>Layer Thickness (Inches)</u>	**<u>Material</u>**
A. 0.100²	Inside Air Film
B.	
C.	
D.	
E.	
F.	
G.	
H.	
I .	
J.	
K.	
L.	
M.	
N.	
O. 0.100"	Outside Air Film
Building Interior Use	
Is The Interior Relative Humidity Controlled?	
If Yes, Describe	
This Information Provide By	
Date	

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