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CARLISLE COATINGS & WATERPROOFING

AIR & VAPOR BARRIER

Vapor Permeability of Fire Resist 705 VP

Summary

Fire Resist 705 VP is an air and water resistive barrier (WRB) which meets International Building Code (IBC) WRB performance requirements and the IBC definition of a "vapor permeable" material. Furthermore, a wall assembly simulation in WUFI 5.3 shows comparable wetting/drying behavior of Fire Resist 705 VP with three common vapor permeable Weather Resistive Barriers (WRBs). This study shows that the vapor permeability of Fire Resist 705 VP promotes year-round effective moisture management in a common commercial stud wall assembly.

Introducing Fire Resist 705 VP

Carlisle Coatings & Waterproofing is proud to launch new Fire Resist 705 VP. Fire Resist 705 VP is a vapor permeable sheet membrane air & water resistive barrier. The product is recommended for use in diverse exterior commercial wall assemblies. Fire Resist 705 VP consists of an engineered fabric fully coated with a permeable acrylic adhesive. The tenacious acrylic adhesive provides robust adhesion in a wide range of service and installation conditions.

Fire Resist 705 VP is a water resistive barrier and air barrier, yet it is permeable to water vapor. Permeability results are shown in the table below.

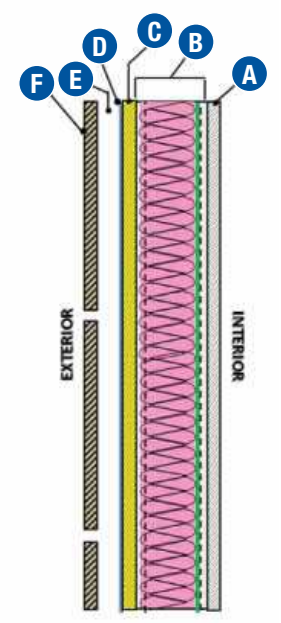
Property	Method	Typical Value
Water Vapor Permeance [Perms]	ASTM E 96 A	9.05
	ASTM E 96 B	10.53
Water Vapor Transmission [g/m²*24h]	ASTM E 96 A @ 23°C	63
	ASTM E 96 B @ 23°C	73
IBC 2009, 2012 and 2015 Vapor Retarder Classification	–	III
ICC-ES AC 38 Grade	–	D

According to IECC-ES AC-38, acceptance criteria for sheet water resistive barriers, Fire Resist 705 VP is permeable (Grade D). Fire Resist 705 VP exceeds the AC-38 minimum Grade D WRB requirement for water vapor transmission of 35 g/m²*24h, ASTM E 96A @ 23°C. Also, according to IBC2015, a perm rating of 5 or more (ASTM E 96 A) defines a "vapor permeable membrane".

Case Study: Wetting/drying behavior of a wall assembly in Zone 4 Marine

As the vapor permeability of products on the market varies, a study was done in WUFI to compare performance of Fire Resist 705 VP to several common WRB membranes. A wall assembly modeled in Zone 4 Marine (Seattle, WA) was chosen. The modeled wall assembly is shown below:

Wall Assembly



- **A** 5/8" interior drywall with latex paint interior finish
- **B** 6" stud cavity: R-19 kraft-faced fiber glass batts
- **C** 1/2" exterior gypsum sheathing
- **D** WRB membrane
- **E** 1" ventilated air space
- **F** Fiber cement board cladding

The wall assembly modeled represents 2X6 steel stud construction with all of the insulation in the stud cavity. Zone 4 is the coldest climate zone where continuous insulation "ci" is not prescribed in energy codes equivalent to International Energy Conservation code (IECC) 2006 or later. Therefore, it is among the worst case scenarios for WRB over cold stud cavity. Cold stud cavities are prone to condensation of interior moisture. This type of wall assembly relies heavily on a vapor permeable WRB to manage wintertime stud cavity moisture. In colder Zones, steel stud wall assemblies are typically built with exterior continuous insulation, which keeps the stud cavity warmer and mitigates the wintertime stud cavity condensation problem.

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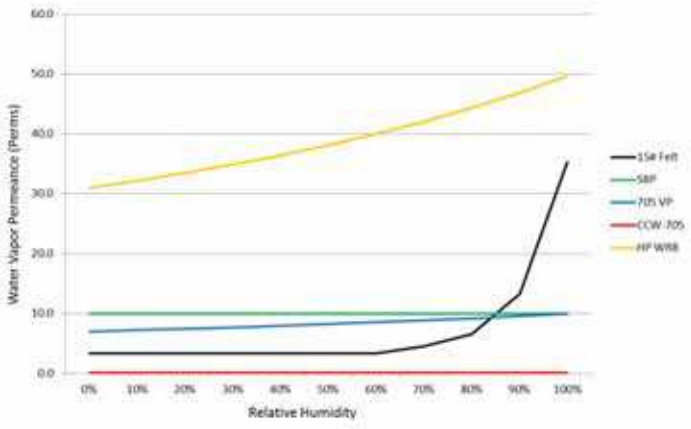
Zone 4 Marine was chosen as it presents a cool, damp climate. This wall assembly experiences moisture loading from the exterior in the form of rain and humidity, and from the interior in the form of heated & humidified air. The exact layering of the wall assembly built in WUFI is shown in the table below:

Position	Material	Thickness (in)
Exterior	Fiber Cement Sheathing Board	0.31496
	Air Space 25 mm w/ 25 air changes per hour	0.98
	WRB (varies)	varies
	Gypsum Board (USA)	0.5
	Fiber Glass	0.03937
	Air Layer 10 mm	0.3937
Interior	Interior Gypsum Board w/ user defined 10 Perm coating on interior	0.625

The WRB materials used in the WUFI simulation were: Bituminous Paper (15# Felt), Spun Bonded Polyolefin Polyolefin (SBP), 705 VP, CCW-705 and High-Perm Water Resistive Barrier (HP WRB). All of the WRB products except CCW-705 are considered “vapor permeable”. The water vapor permeance of these materials versus relative humidity is shown in the graph below:

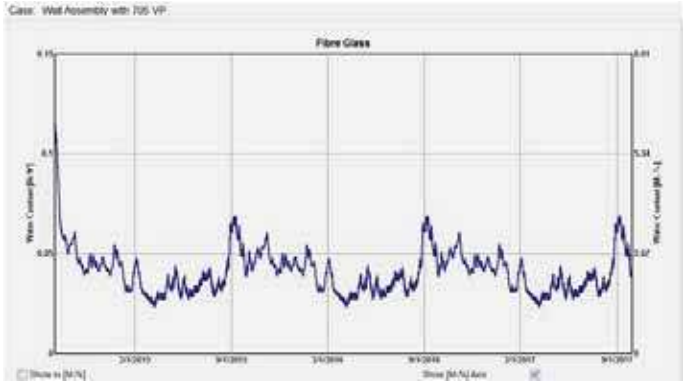
Permeance of WRB Products in WUFI Simulation



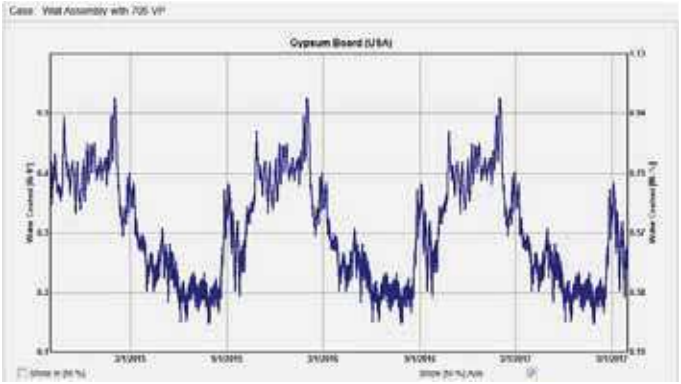
The wall assembly was modeled in WUFI 5.3 using exterior climate file “Seattle Cold Year” and interior sine curves for “Medium Moisture Load”. The exposure used was the middle portion of a tall building, northwest orientation. A northwest orientation was chosen to minimize the solar effect of warming and drying and to maximize rain exposure. A three year simulation was run to spot trends in wetting/drying of the assembly.

The wall assembly with each of the WRB products showed good wetting/drying behavior. The 3-year moisture content of the exterior gypsum and the fiber glass batt insulation is shown below for the wall assembly run with Fire Resist 705 VP.

3-Year Moisture Content of Fiber Glass Batts



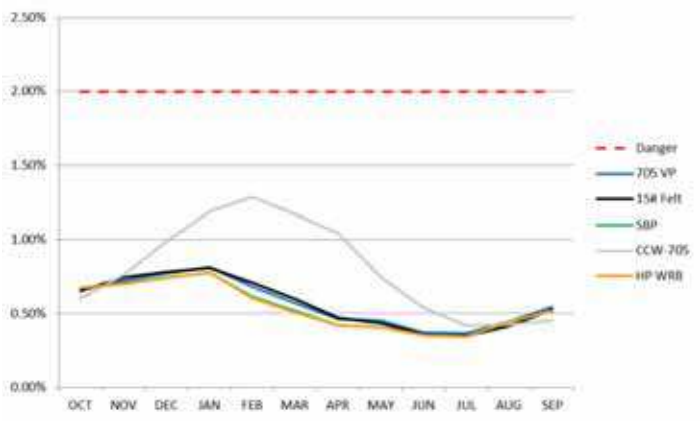
3-Year Moisture Content of Exterior Gypsum Sheathing



The three-year simulation plots indicate overall good behavior, as these materials do not accumulate moisture over the three year simulation, and the moisture content levels stay within acceptable range.

A comparison of performance for all of the WRBs run in the wall assembly is shown below. The average monthly moisture content in % by mass is shown for the exterior gypsum sheathing in year 3.

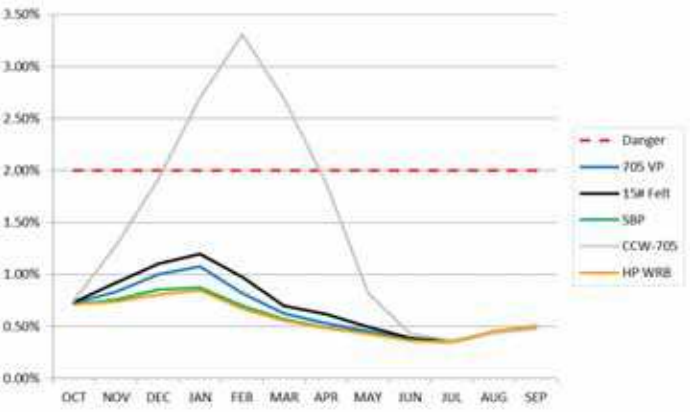
Base Case, Year 3
Exterior Gypsum Sheathing
Average Moisture Content by Month



The simulation of the subject wall assembly using each of the WRB products indicates the exterior gypsum sheathing moisture content remains well below the 2% danger threshold. The wall assembly modeled with Fire Resist 705 VP very closely follows the behavior of the other permeable WRB products.

The base case scenario assumes perfect construction of all the layers, and no water leaks. A wall assembly should be robust and forgiving of common construction defects. An area of vulnerability in this wall assembly is the kraft paper facer on the glass insulation batts. The facer is there to prevent interior airborne humidity from reaching the cold side of the insulation and forming condensation. In practice, it is difficult to have perfect continuity of the batt insulation facer. Therefore, a common scenario of missing, damaged or displaced kraft paper facer was simulated by removing the kraft paper layer in WUFI and re-running the simulation. This resulted in greater wintertime moisture content of the glass batts and the exterior gypsum sheathing. Comparative results are shown in the graph to the right:

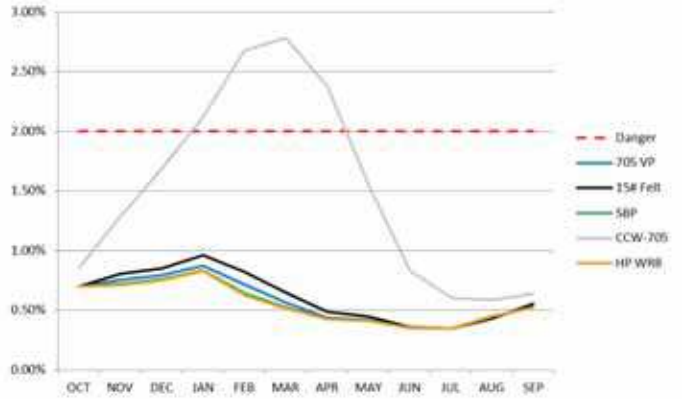
Missing or Damaged Kraft Facer,
Exterior Gypsum Sheathing
Average Moisture Content by Month (Year 3)



With a missing interior vapor retarder, the wall assembly built with CCW-705 shows unacceptably high moisture levels in the exterior gypsum sheathing. The good thing is that it dries out, due to the permeability of the kraft paper facer. Fire Resist 705 VP and the other permeable WRB products maintain the moisture level of the exterior gypsum sheathing well below the 2% danger level, even when the interior vapor retarder is imperfect or missing.

Another common scenario is water leakage past the WRB due to imperfect flashing or laps details, or unsealed penetrations. To model this scenario in WUFI, the base wall assembly with the kraft faced batts was modeled with 1% of all driving rain entering the stud cavity. The results are shown in the graph below:

1% Leak into Stud Cavity
Exterior Gypsum Sheathing
Average Moisture Content by Month (Year 3)



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With a 1% moisture leak into the stud cavity, the wall assembly built with CCW-705 shows unacceptably high moisture levels in the exterior gypsum sheathing. However, this moisture is allowed to dry out, due to the permeability of the kraft paper facer. Fire Resist 705 VP and the other permeable WRB products maintain the moisture level of the exterior gypsum sheathing well below the 2% danger level, even with 1% of driving rain entering the stud cavity.

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