

Effect of Vapor Diffusion Port on Drying of Wood-Frame Walls

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1 Introduction

Little research work has been done to investigate the effect of VDPs on building assembly durability, mainly two laboratory experiments. Hazleden and Morris (2001) found that for OSB sheathed walls, VDPs had a substantial effect on drying, but not for plywood sheathed walls. Wang (2018) concluded that VDPs had insignificant effects on drying for assemblies sheathed in OSB or plywood. This study aims to provide a more comprehensive and systematic evaluation of the effect of VDPs through transient hygrothermal simulations.

2 Methodology

A Wufi-2D model is firstly validated by comparing simulation results with the measurements from a recent experiment conducted by Wang (2018). The validated model is then used for a parametric study to evaluate the effect of VDP.

The experiment by Wang (2018) was carried out for a variety of wall assemblies, with OSB and plywood sheathing, with and without exterior insulation, and a wetted wood block placed above the bottom plate was used as the moisture source. The hygrothermal model is set up to represent the test configuration as close as possible. The comparison between 28 simulation cases and experiment results is done by root-mean-square error (RMSE), ranging from 0.38 to 4.72 with a median value of 1.49.

Following validation, a baseline assembly is simulated of 140 mm deep, fiber cement clad wall cavity, sheathed in OSB with no exterior insulation. 1% fraction of driving rain is applied uniformly on the sheathing as an ongoing moisture source. Vancouver weather data is used, and the assembly is facing east, the prevailing wind-driven rain direction.

3 Results and Discussion

3.1 MC Analysis

3.1.1 Baseline case

During the autumn and winter there is intake of sheathing MC from the environment and rain penetration. Spring until autumn, the assemblies dry out to the exterior. The VDP assembly is up to 3.8% MC dryer and the time to dry from maximum MC to under 20% MC is shortened by 22 days. Other than the beginning of the first winter, the assembly with the VDP has a lower value of MC for the rest of the simulation duration. During dryer periods the MC with and

without VDP is similar, and there is no observed effect of moisture intake from the environment due to the VDP. Results for the bottom plate MC are similar but diminished.

3.1.2 Effect of wall orientation

Increasing solar exposure and decreasing rain deposition causes lower MC and VDP effects.

3.1.3 Effect of sheathing materials

Plywood sheathing is used in place of OSB. For high intensities of wetting, VDPs can be beneficial in plywood too.

3.1.4 Effect of adding exterior insulation

76mm mineral wool exterior insulation causes significantly lower MC and consequently lower VDP benefits, however some benefit remains with no adverse effects.

3.2 Mold Index

Mold index is calculated and compared. No improvement in mold index was found.

4 Conclusions and Discussions

Vapor diffusion ports have an ability to modestly improve the rate of drying for wall assemblies with an on-going moisture source of rain infiltration on the sheathing layer. Table 1 summarizes the improvement of MC (max and root mean square difference), mold-index, and number of days to dry to under 20% MC due to VDP effects. The higher the MC of the assembly, the greater the potential contribution of the VDP to drying. The provision of VDP also reduces the time for OSB sheathing to dry to below 20% MC, as shown in Table 2. However, the effect of VDP on the mold growth risk is negligible.

Table 1. Summary of improvement in MC and mold-index due to VDP effects.

Simulation inputs			MC - Max [%]	MC- RMSD [%]	Mold index	Time to dry under 20% MC [days]
Sheathing	Exterior insulation	Orientation				
OSB		East	-3.85	-1.50	0.02	-22
OSB		South	-1.09	-0.44	0.00	NA
Plywood		East	-4.85	-1.84	0.37	-38
OSB	Mineral wool	East	-2.19	-1.07	0.10	-17

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