ROCKWOOL

Research Summary
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Field Study of Exterior Walls in a Hot and Humid Climate

In-situ monitoring and performance analysis of stone wool exterior insulation

Project Overview

Hot and humid climates, ASHRAE Climate Zones 1-3, experience high solar radiation and moisture loads with inward vapor drive a concern from a performance and durability perspective[1]. To validate the use of vapor permeable stone wool insulation in this climate, field monitoring of three wall assemblies was conducted at the Oak Ridge National Laboratory (ORNL) Natural Exposure Test (NET) facility in Charleston, SC. Two of the assemblies were mass walls with high absorptive cladding, and the third assembly was light-weight wood frame construction with a vented cladding. All the assemblies incorporated ROCKWOOL® stone wool continuous insulation.

Test Assemblies Description

The study was divided into two phases: Year 1 and Year 2. In Year 1 Wall 1 did not have a dedicated water resistive barrier (WRB) and Wall 2 incorporated a vapor permeable exterior WRB, both representative of a fully vapor open assembly. In Year 2, a WRB was added to Wall 1 and changed in Wall 2 to a semi-vapor open membrane. In addition, Year 2 also included a light-weight wood frame construction wall, representative of a typical residential assembly. All assemblies were designed to meet ASHRAE 90.1-2016 prescriptive requirements for Climate Zone 3.

Table 1: Wall Assemblies Description – Year 1 & 2

Year 1		Year 2		
Wall 1a	Wall 2a	Wall 1b	Wall 2b	Wall 3
1/2" drywall + latex paint	1/2" drywall + latex paint	1/2" drywall + latex paint	1/2" drywall + latex paint	1/2" drywall + latex paint
1 x 3 furring strips	3.5” steel stud @ 16” o.c.	1 x 3 furring strips	3.5” steel stud @ 16” o.c.	2 x 6 wood stud @ 16” o.c.
3” (R-12) ROCKWOOL Comfortboard™ 110	3.5” (R-15) ROCKWOOL Comfortbatt®	3” (R-12) ROCKWOOL Comfortboard™ 110	3.5” (R-15) ROCKWOOL Comfortbatt®	3.5” (R-15) ROCKWOOL Comfortbatt®
8” CMU, fully grouted	5/8” gypsum sheathing	Self-adhered, air and water resistive barrier (12 perm, dry-cup)	5/8” gypsum sheathing	1/2” OSB
1/8” stucco	SBPO water resistive barrier (54 perm, dry-cup)	8” CMU, fully grouted	Self-adhered, air and water resistive barrier (12 perm, dry-cup)	SBPO water resistive barrier (54 perm, dry-cup)
	2” (R-8.3) ROCKWOOL Cavityrock®	1/8” stucco	2” (R-8.3) ROCKWOOL Cavityrock®	1.5” (R-6) ROCKWOOL Comfortboard™ 80
	1” air space, ventilated		1” air space, ventilated	½” x 3” plywood furring
	Brick veneer		Brick veneer	Vinyl siding, vented

[1] For more info, refer to Exterior Wall Solutions for Hot-Humid Climates.

Methodology

The test walls were 4-ft by 8-ft, South-facing and thermally separated from each other and the surrounding walls. Each test wall was outfitted with a series of temperature (T), relative humidity (RH), and heat flux (HF) sensors at all critical layers; and continuously monitored throughout the full testing period. Main sensor locations include the exterior and interior sides of the exterior stone wool insulation and sheathing/CMU, and the exterior side of the interior drywall.

To assess the performance of each assembly, the RH and partial vapor pressure was analyzed throughout the layers. In addition, during the deconstruction of Wall 1 and 2 between Year 1 and 2, the walls were visually inspected for mold and/or moisture damage.

Results

As expected, the vapor pressure profiles demonstrated inward vapor drive in the summer months and lower outward drive in the winter months for all assemblies. Although peaks of higher moisture were noted in some assemblies, a diurnal fluctuation of the vapor profile indicate no accumulation of moisture within the wall assemblies. In addition, no mold or moisture related issues were noted during deconstruction of all assemblies after both Year 1 and Year 2.

Wall 1 – CMU and Stucco Finish

In Year 1, the CMU substrate had high RH levels largely attributed to construction moisture, specifically the mortar fill. However, in Year 2 the CMU clearly demonstrated drying of initial moisture levels indicated by the lower overall RH levels. On the interior side of the assembly, high RH levels are noted in the summer months of Year 1 caused by inward vapor drive. In Year 2, due to the drying of initial moisture and the addition of the WRB membrane, the interior RH levels within the assembly were significantly lower.

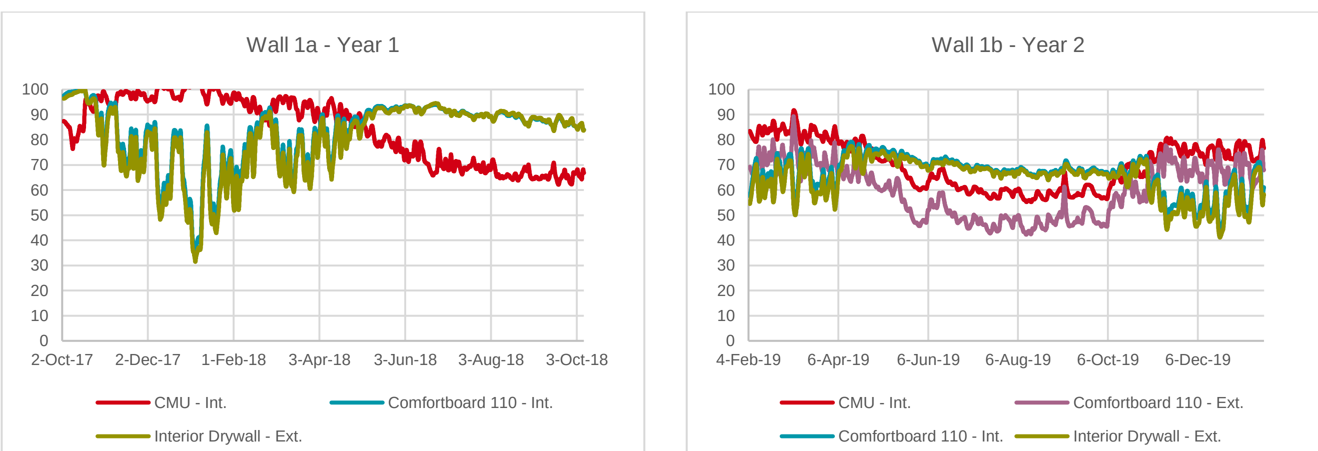

Figure 1 & 2: Wall 1, Year 1 and Year 2 relative humidity (RH) levels, 24hr running average

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Wall 2 – Steel Stud with Brick Veneer

The RH levels within the assembly remained below the desired threshold of 80%. The exterior surface of the interior drywall had the highest peaks in the summer months due to inward solar drive. The change to a lower perm WRB in Year 2 resulted in lower overall values. Even with the highly absorptive brick cladding, the ROCKWOOL Cavityrock® demonstrated adequate drainage and drying without any indication of potential moisture accumulation within the wall assembly.

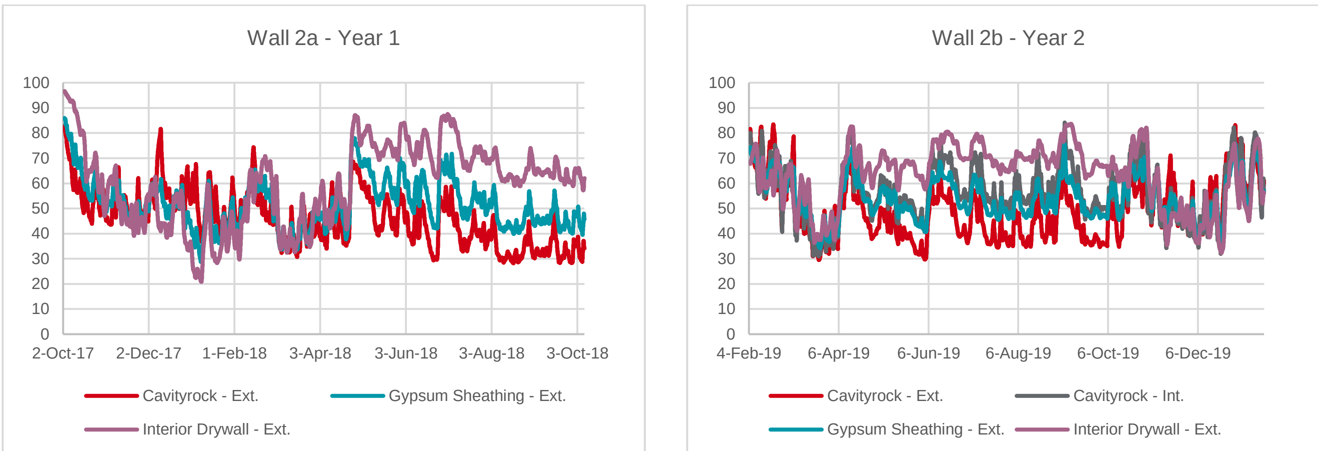

Figure 3 & 4: Wall 2, Year 1 and Year 2 relative humidity (RH) levels, 24hr running average

Wall 3 – Wood Stud with Vinyl Siding

The RH levels within the assembly remained below the desired threshold of 80%, specifically for the OSB sheathing and interior drywall. The short peaks of higher moisture on the exterior side of the assembly demonstrate effective drainage and drying of the ROCKWOOL Comfortboard™ 80 continuous insulation.

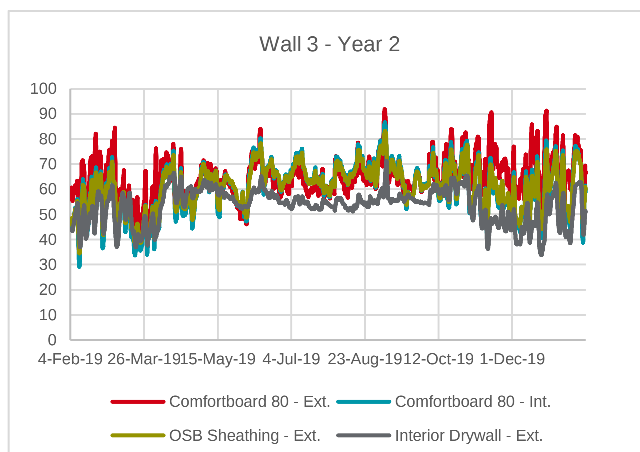

Figure 5: Wall 3, Year 2 relative humidity (RH) levels, 24hr running average

Conclusions

Overall, the results of the study demonstrate that vapor permeable stone wool insulation can be used in a hot and humid climate. The ROCKWOOL stone wool insulation did not demonstrate signs of moisture accumulation and drained and dried effectively. Attention to moisture loads including construction moisture and inward vapor drive is required. In addition, the use of a vapor semi-permeable membrane assists in limiting high moisture levels on the interior side of the assembly.

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