Cold Climate Housing Research Center

Promoting and advancing the development of healthy, durable, and sustainable shelter for Alaskans and other circumpolar people through applied research.

CCHRC Research Snapshot 07-03

REMOTE

Residential Exterior Membrane Outside -insulation TEchnique

February 26, 2007

Please visit the CCHRC website for additional information and to view progress reports on this and other studies conducted at the Cold Climate Housing and Research Center.

http://www.cchrc.org/Reports

The Building Enclosure

The design of the building enclosure is one of the most crucial elements in making a home healthy, durable, and efficient. The building enclosure or envelope must provide support along with providing protection from outside elements (wind, water, soil gas and extreme temperatures) and also from interior water vapor. To do this effectively, the building must be sealed. The number of holes cut in the envelope for heating, plumbing and electrical conduits & the number of different contractors cutting these holes makes it virtually impossible to get a perfect seal. An imperfect seal allows water vapor into the building envelope where it can compromise the insulation and the building support if not allowed to dry out.

> **The Challenge:** ***How can the building envelope be sealed from exterior precipitation & interior water vapor without trapping the inevitable leakage of moisture inside the envelope?***

The REMOTE wall system was designed to address the problem of water vapor in residential building components. The discussion below covers the basic science & history behind this building technique.

REMOTE wall under construction in Fairbanks, Alaska showing vapor barrier, insulation, window framing and furring in place for siding.

Moisture Control

Building assemblies need to control the migration of moisture both by vapor diffusion & vapor pressure. Water vapor will move from areas of higher concentrations of water molecules to lower concentrations (wetter to drier), or areas of higher air pressure to lower air pressure. Moisture will also move from warmer areas to colder areas. Water vapor can condense on a relatively cooler surface. This creates greater problems as the condensation now lowers the vapor pressure in that site which acts as a further magnet for moisture. Moisture inside the building envelope can cause structural damage to wood framing and drywall, lower the effective value of the insulation in the envelope & cause indoor air quality problems by creating an environment allowing for mold growth.

REMOTE wall under construction showing exterior vapor barrier, deck blocking & window detail.

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In cold climates, moisture often moves from the living space (where it is relatively warm & moist) toward the exterior through the building envelope until it reaches the dew point & condenses. To address this, common practice has been to install a vapor barrier on the interior side of the framing & insulation. As noted above, this method is less than perfect due to the many penetrations necessary. Since it is likely that some moisture will get into the wall, it needs a way out before damage can occur, so the exterior needs to be vapor permeable.

This has worked fairly well in cold, dry climates, but requires great care in installing and sealing the vapor barrier (labor intensive) and fails in cold, wet climates where the building must be sealed on the outside of the envelope.

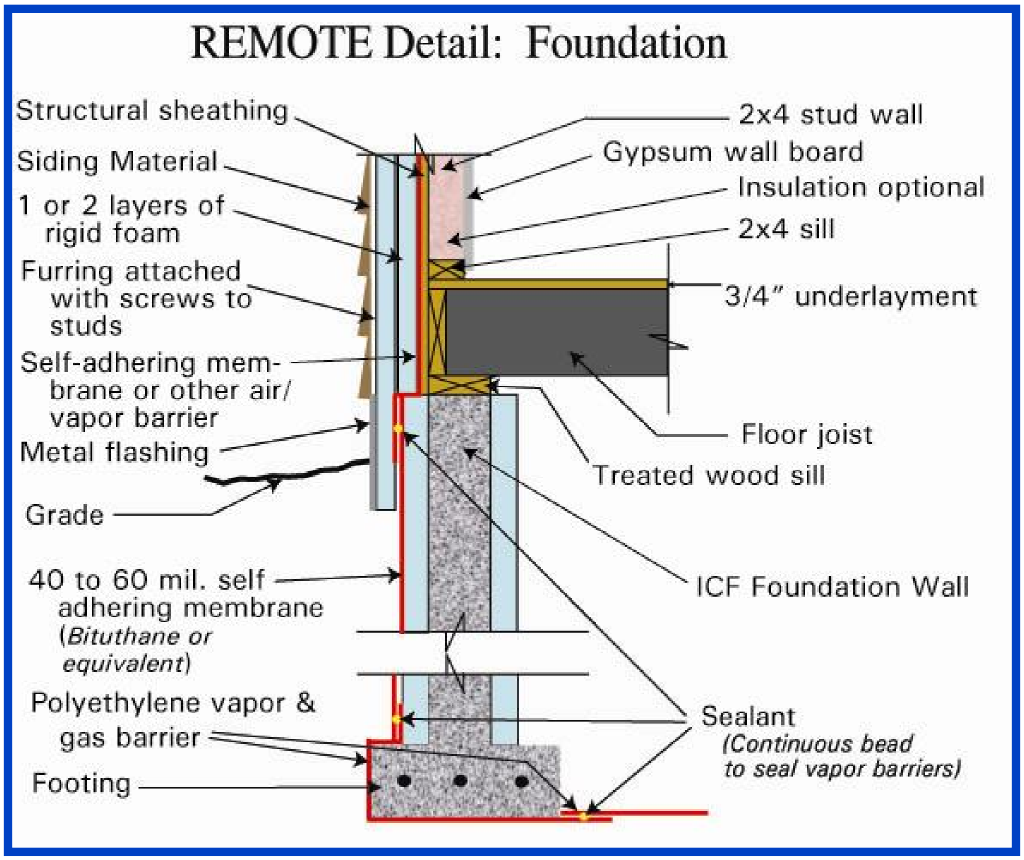
PERSIST (Pressure Equalized Rain Screen Insulated Structure Technique) is, in simple terms, a peel-and-stick impermeable membrane located on the exterior of a framed structure with foam insulation to the exterior of the membrane. This method of construction protects the framing components from precipitation and keeps them on the warm side of the thermal envelope. In PERSIST, a 'second' roof is required to provide an overhang and protective roofing material.

REMOTE is an Alaskan modification of the PERSIST technique which allows more space for insulation in the roof of a structure and eliminates the need for constructing the 'second' roof. This modification allows for more cost effective construction and a higher R-value where it is most needed; in the ceiling. While PERSIST wraps the structure on 5 sides, REMOTE wraps the structure on 4 sides & allows more flexibility in handling the ceiling and floor.

Wall Design— The benefit of insulation on the exterior of the structure is twofold:

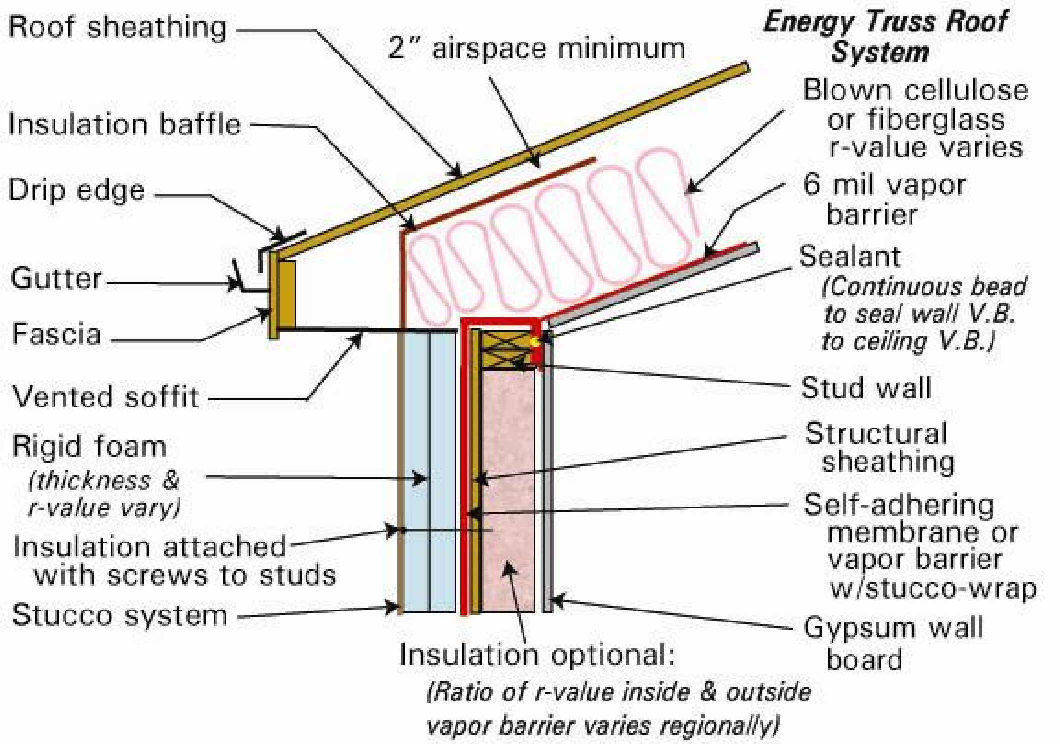
1) With insulation installed to the exterior of the structure, condensation within the building envelope is eliminated. The dew point is now located outside the moisture barrier and not inside the wall structure. Any precipitation that penetrates the exterior sheathing can drain off.

2) The exterior insulation also eliminates concerns of thermal bridging in the framing significantly increasing the effective R-value of the insulation. With cavity insulation, the framing members can reduce the rated R-value of the insulation up wards of 35% to 40%. With the REMOTE wall, the warm interior allows the building components to dry to the inside.

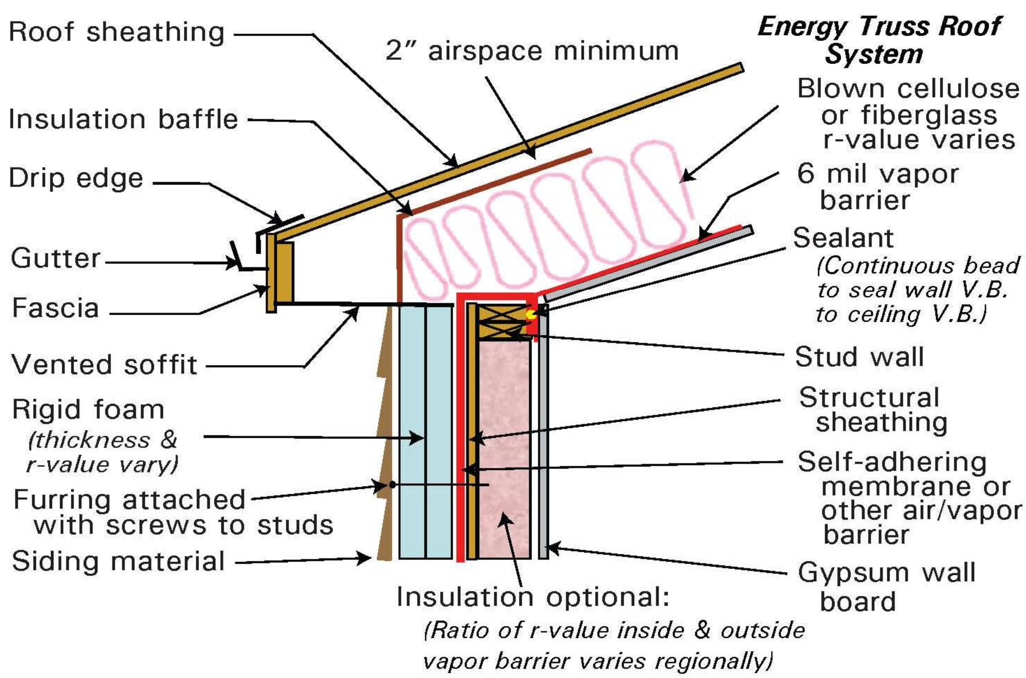


This REMOTE Detail shows how wall components are connected to a foundation. Foundation details are not included due to the variety of foundations possible.

REMOTE Detail: With Stucco



REMOTE Detail: With Siding



The outside-insulation technique allows building with 2x4 walls, which saves on material costs.

Insulation in the stud cavity is optional but care must be taken not to include an R-value amount that would move the dew point back inside the wood framing (see chart on pg. 4). Research in cool, wet climates shows that stud cavity insulation may be better left out entirely to improve the capability of the wall to dry from the inside.

Research has proved that the REMOTE shell creates a very tight air envelope. This mean that very little energy is wasted heating infiltration air, but like any tight wall system, requires a good mechanical ventilation system. Sealed combustion appliances in the living area are required or make-up air must be provided.

Research Results

Final Reports of all these studies can be found at: http://www.cchrc.org/Reports.

REMOTE Wall System Study:

In 2002, CCHRC undertook a study to assess the performance of two residential dwellings in Fairbanks. Both structures were fairly new & constructed by the same builder. One employed a standard wall system with an interior vapor/air barrier and the other used the REMOTE wall system. The wall components interior of the sheathing in the REMOTE construction never approached the dew point and the air tightness was much better than that of the standard house.

Building America in Alaska Report:

In 2004, a building technology class in Juneau tested wall section performance in S.E. Alaska in a Mobile Test Lab developed by CCHRC. Nine wall sections were examined using styles commonly used in the area and a REMOTE style wall. The moisture content of the structural sheathing increased in every wall during the monitoring except the REMOTE wall.

Mobile Test Lab—Wall Systems for South East Alaska:

A follow-up study in 2005-2006 used the Mobile Test Lab to evaluate eight REMOTE wall sections with different components & included wetting of the stud space to determine the drying capacity of the wall sections. The results showed the walls performed well except for two sections that included insulation inside the stud cavity which retained elevated humidity inside the wall at a dangerous level.

A house using the REMOTE wall system building technique under construction in Juneau, Alaska.

Suggested maximum cavity insulation for an Exterior-Insulation type wall for selected Alaska cities*

Heating Degree Days	Not to exceed Fraction of Insulation on Warm Side of Vapor Barrier	Alaskan Cities within Selected Heating Degree Day Range
Less than 12,000	1/3	Juneau, Anchorage
12,000—14,000	1/4	Bethel
Greater than 14,000	1/5	Fairbanks, McGrath, Nome, Kotzebue, Barrow

***** *The heating degree days can vary greatly within an area due to micro-climates. For example, a site in the hills around Fairbanks may experience less than 14,000 heating degree days due to temperature inversions common in winter.*

Mobile Test Lab with wall sections in Juneau