

Wrap it Up!

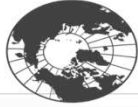
REMOTE Wall Construction & Energy Efficiency

with Margaret Subers

R.E.M.O.TE

Residential Exterior Membrane Outside-insulation TEchnique

- REMOTE (Modified PERSIST)
- An Alaskan Approach to a Canadian Concept
- A Performance Study (In progress)



COLD CLIMATE HOUSING RESEARCH CENTER

CCHRC

Persist-Pressure-Equalized Rain-Screen Insulated Structure Technique

What is REMOTE?

How can this building style get YOU on the path to net zero?

What to take with you from this presentation?

- Understanding of the basic dynamics in building science that influences the homes we live in.
- Identify the components necessary for a safe, durable and healthy home.
- Improve/advance your steps toward NET ZERO ENERGY and a more comfortable home with reduced energy costs!



What is Outside Insulation Technique?

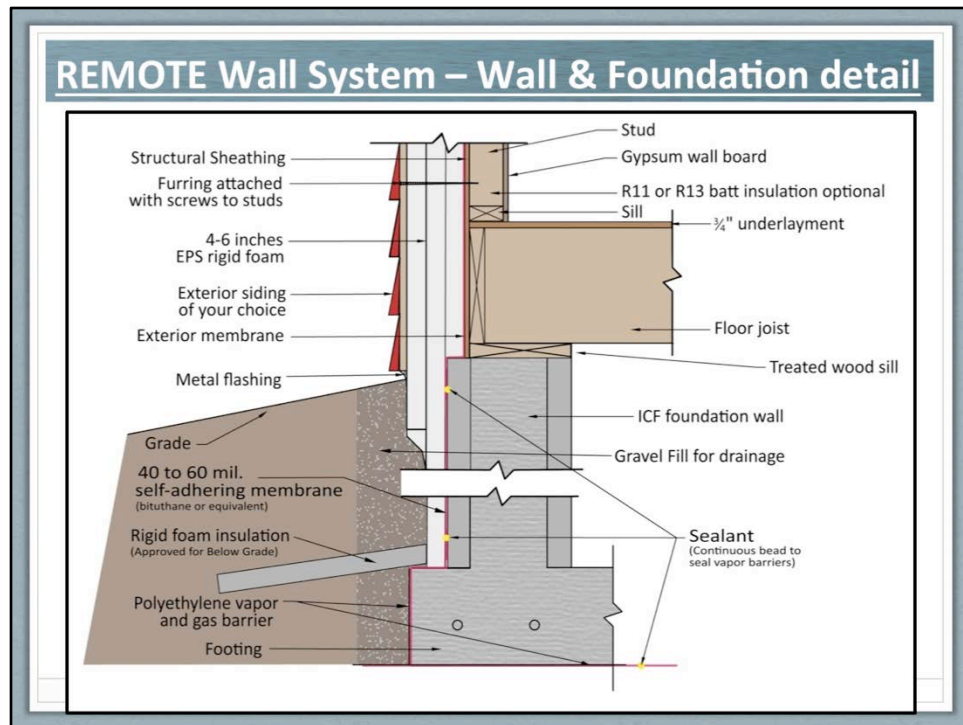
- Rigid insulation as “sheathing” OVER and OUTSIDE the plywood or OSB that completely wraps the framing members that make up a wall/ceiling/floor assembly.
- The traditional “vapor barrier” is relocated to the outside of the plywood or OSB, then rigid foam sheathing is installed on the outside over the vapor barrier.
- Vapor barriers can consist of “self-adhering” membrane, 6-mil poly or Tyvek® DrainWrap™

As opposed to a standard construction method using a interior vapor barrier, stick framing and siding on outside of plywood or sheathing.

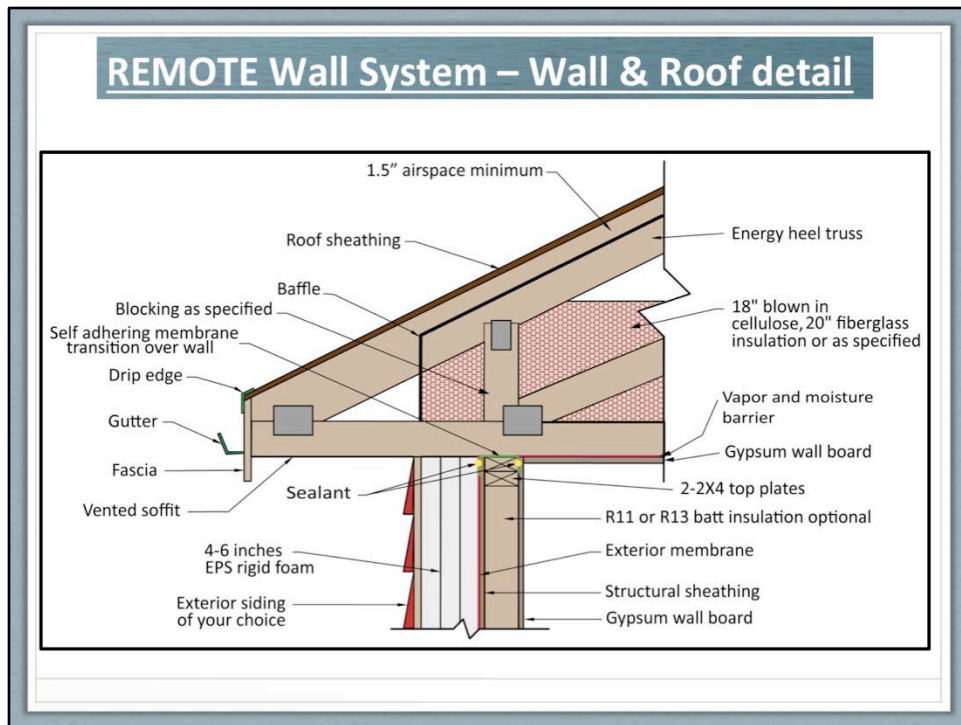
How can R.E.M.O.TE get YOU on the path to net zero?

- *Conservation* of BTU's (1 kitchen match = 1 BTU)
 - Superior air sealing of home
 - Super insulated walls and attic
 - Saves integrity of structure

Traditional stick frame construction can be more time consuming and in addition to that, the dew point in a 2 x 6 wall in very cold temperature with a standard interior vapor barrier will typically be within your wall cavity!



Details of this are in your manual and on the CCHRC.org website



Insulation at attic must “envelope” the building and connect with the wall insulation. Interior vapor barrier connections are especially important at the eave.

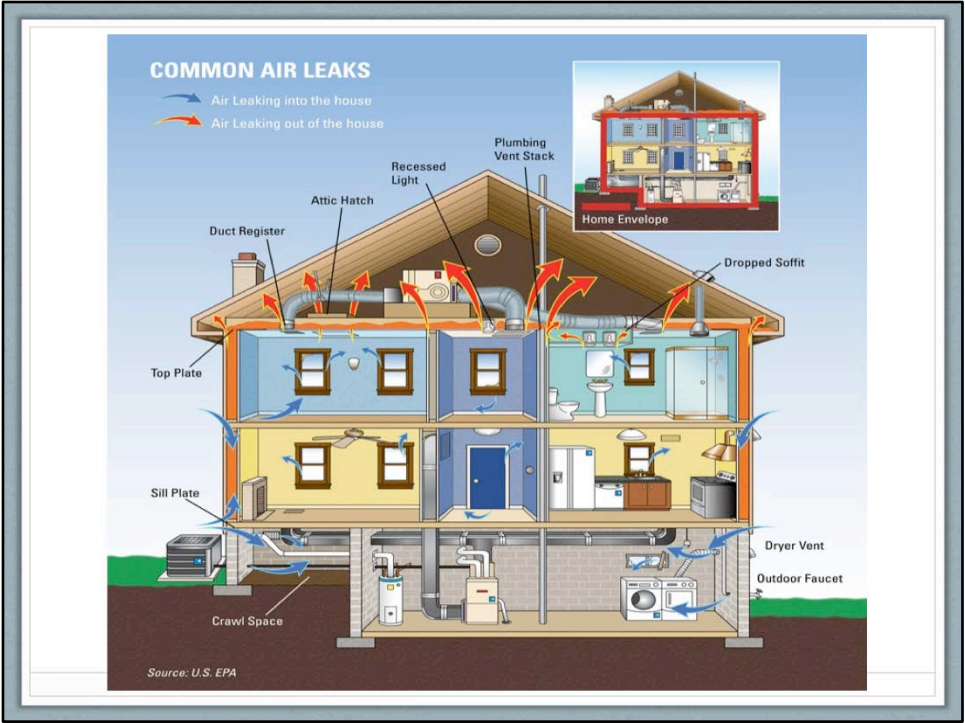
Start from the Ground Up!



If building with new construction it is important to work the REMOTE details into your foundation. It is relatively simple. You just have to prepare for it ahead of time.

Pressure and Thermal Boundary

- **The Pressure Boundary**
is the air block between **Conditioned indoor air** and **Unconditioned outdoor air**.
- **The Thermal Boundary**
is the insulation between **Conditioned indoor air** and **Unconditioned outdoor air**.



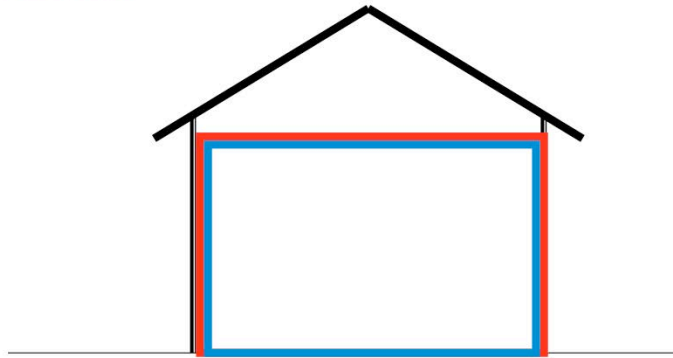
Defining the Pressure Boundary



In remote, a membrane is attached around the top plate for a contiguous seal. The wall and ceiling and footer are all encased to the slab

Pressure and Thermal Boundaries

- The **Pressure Boundary** and **Thermal Boundary** must be together and continuous.



REMOTE new construction with self adhering membrane



Examples of pressure boundary

Examples of pressure boundary on different homes. All six exterior sides of a home should have a pressure boundary.

REMOTE new construction with 6-Mil Poly



CCHRC has tried various methods to try and reduce costs for any building method. At one point they used poly with tyvek wrap together. Now the newest method is the Tyvek Drain Wrap.

REMOTE new construction with Tyvek Drain Wrap over OSB



Think like air!

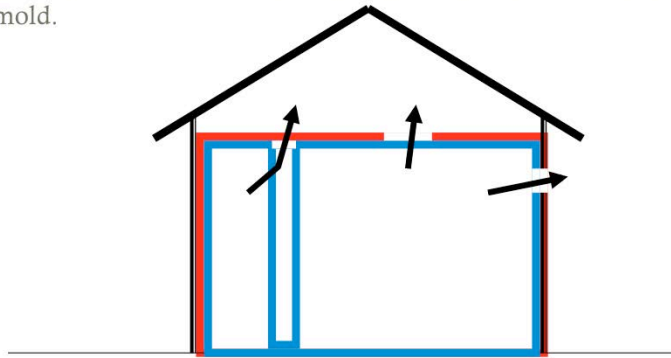
Think like water!



Window and door details are important. Think like water. Think like air.

Pressure and Thermal Boundaries

When boundaries are misaligned, have holes, voids or gaps , the building will be difficult to heat . In addition, moisture can develop in these pockets of misalignment, creating the breeding grounds for mold.



Interior partition walls, floor/wall/ceiling connections are typical places for air leakage as well as attic bypasses and wall penetrations.

Make it continuous!

Simpler than it “seams”!



This is the kind of detail that is simpler than it “seams”! Peel and stick membrane works best for the top plate and exterior portions of foundation insulation. Really it is that we don’t want the water accumulating on the inside of our wall where we typically get our Make up air!

The Moisture issue.

Controlling the moisture generated in the interior living environment and preventing it from escaping into a home building shell is one of the biggest challenges of home building in cold climates. The physics governing temperature, pressure, and humidity imbalances contribute to a phenomenon referred to as “vapor drive.” Moist indoor air will migrate through any deficiencies in a building wall assembly in order to reach equilibrium with the outside environment. In conditions where high indoor humidity levels coincide with significant indoor-outdoor pressure and temperature differences, traditional vapor retarder systems can fail due to imperfect sealing. Any penetrations—such as those caused by electrical outlets, fasteners or vents—create vulnerabilities if they are not detailed meticulously. As a result, any moisture that migrates through an imperfect interior vapor retarder can condense and become trapped in the wall. If these conditions persist, mold and rot can grow inside the building envelope. Mold growth can cause major structural and health problems.

House As A System

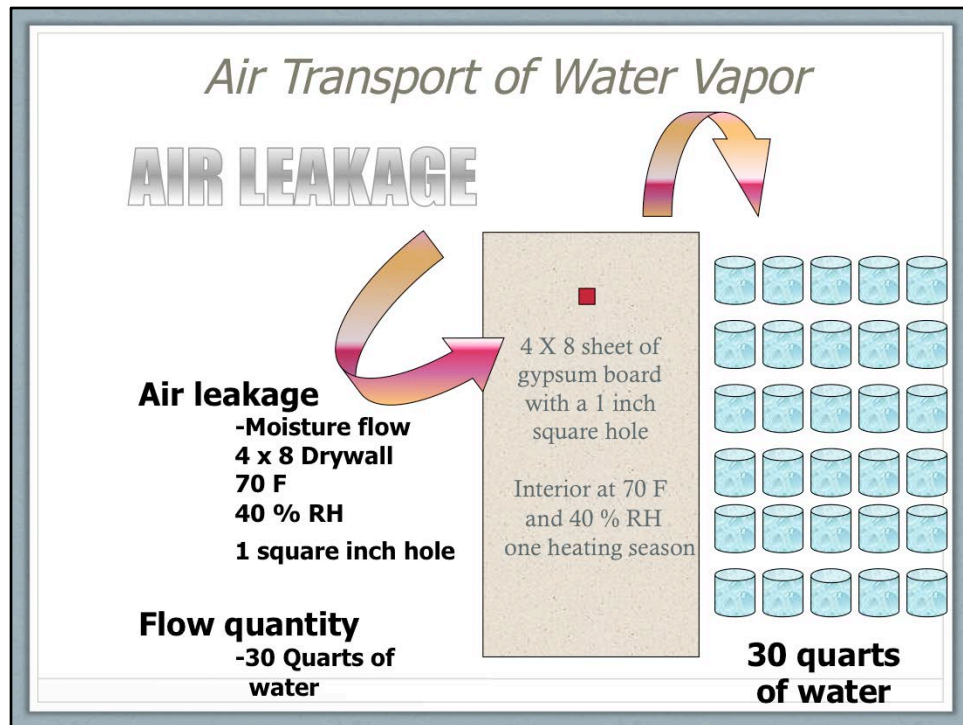
Achieving true energy savings is the result of treating the dwelling as a system of three interactive parts

Part One is the **shell** of the house which keeps cold air out in the winter and lets fresh air in during the summer

Part Two is the **equipment** in the home that adds to or makes the heat, air, and moisture move in your house

Part Three is the **people** in the home who control the shell and operate the equipment

The occupants are one of the biggest factors in moisture control and IAQ.

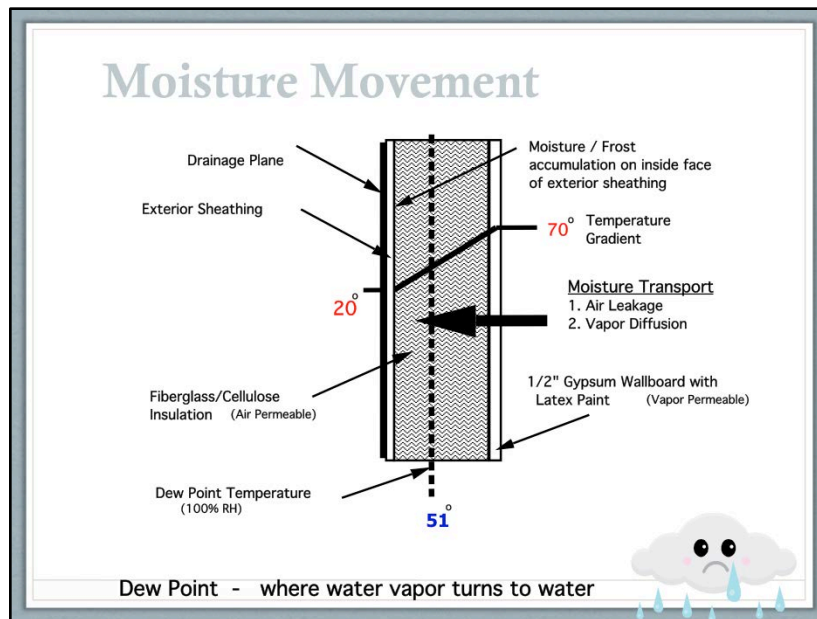


There are many sources of moisture in a home. Moisture can range from dew point condensation, water leaks from roof/windows/doors/pipes, underground water drainage issues and finally the occupants and activity of the home. With our energy efficient Alaska homes we don't have enough air movement for evaporation of this moisture.

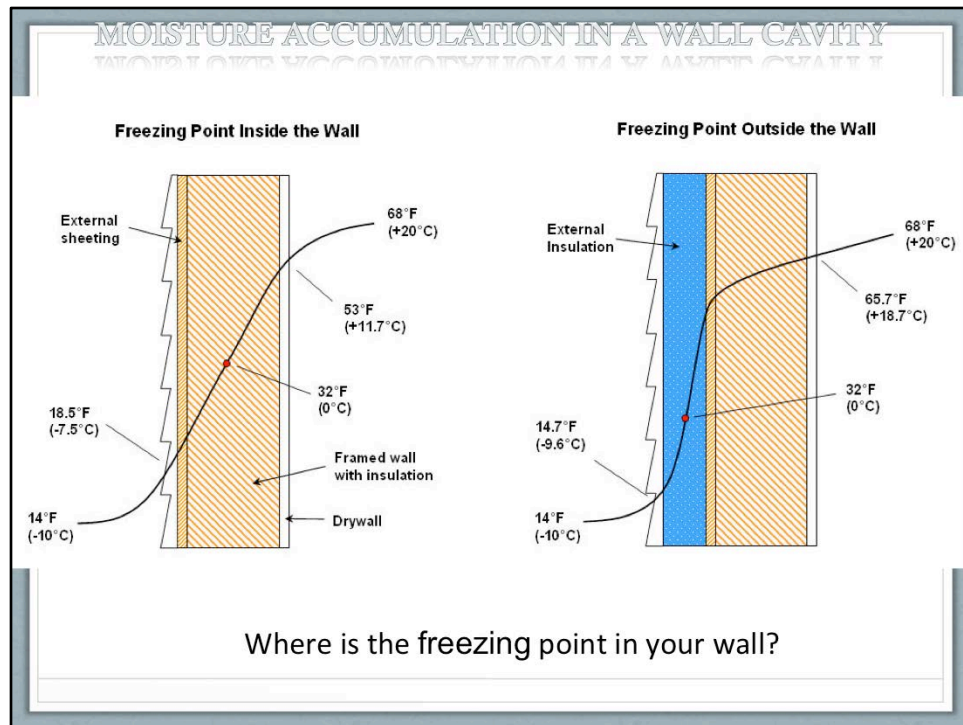
Building Science: Moisture

- Moisture wants to move from areas of high vapor pressure to areas of low vapor pressure
- When the home is being heated, moisture wants to move to the outside, and when it is being cooled moisture wants to move to the inside of the home.

Moisture wants to move from areas of high vapor pressure to areas of low vapor pressure. Vapor pressure is the pressure exerted by water molecules in a mixture of air. An example: when the home is being heated, moisture wants to move to the outside, and when it is being air conditioned, moisture wants to move from the outside to the inside of our homes.



One more way to look at it. This is one the most important points of a remote or outside insulation technique. Where is the dew point in the wall. Remember that with conventional construction, in very cold temperatures, it is always in the wall cavity. Typically in most of Alaska, there are not enough days of temps higher than 70* for drying the inside of the wall cavity!



This is where the proper insulation proportions OUTSIDE your wall really shine. They push the dew point outside of your wall cavity. Moisture in a wall cavity will freeze when temperatures drop.

Vapor Barrier . . .it's all in the details!



Gable transition of scissor truss to attic truss. Top plate to ceiling vapor barrier connection (wall to ceiling connection is covered!) Finally blocking for decking or overhangs are relatively simple.

Remember to find out what your local codes are for any construction project...new or remodel. Remember to attend ACAT's upcoming presentation for Green Building Codes for a small planet.

With no interior wall vapor barrier, completing work is easier for electrical boxes, ductwork and light fixtures. . . Literally a breeze to install. . .



...instead of breeze coming thru them!

No interior vapor barrier makes electrical boxes, ductwork and light fixtures a breeze to install instead of breeze coming thru them. I am sure you have been in homes, maybe your own, where you feel wind whistling through the walls. By the way, cold air drafts through your insulation (typically fiberglass) de-rate your effective R-Value.

Ceiling Interior Vapor Barrier



It is important to leave enough of a lap on the top plate “peel and stick” membrane to be able to connect your interior ceiling vapor barrier. In any construction job you must plan ahead. This type of construction is in some cases easier, but it is new to the standard way of doing things, this can make it seem slow at first.

The Insulation issue.

Exterior walls comprise the largest surface area of the building shell in a typical home. As a consequence of this, an under-performing wall system is often responsible for a majority of space heating costs. High fuel prices have shown that standard 2x6 wood construction methods can be costly to sustain. The walls lack sufficient insulation and suffer heat loss through thermal bridging in the wood framing components, further reducing the insulating value. Depending on layout and construction methods, a standard wood-framed wall contains between 11% and 20% wood. Wood has an R-value of about 1.25 per inch, reducing the overall R-value in a wall despite the addition of fiberglass batting. In addition, the fiberglass insulation must be installed with extreme care. Just 3% of insulation voids in an R-21 wall will drop the overall insulation value to R-17 or less. If insulation becomes wet due to moisture infiltration, or if air leakage is factored in, then the R-value of the wall assembly can drop dramatically. The bottom line: a better approach to wall systems is required to overcome the many challenges in cold climate construction.

In addition to high fuel costs there is something more to consider. REMOTE done properly provides comfort to the occupant and a quiet draft free home.

Now for the Thermal Boundary!



After the pressure boundary (vapor barrier/air barrier are all one) you are ready to install the foam.

Let the wrap begin...

First 4" Layer



Second 4" Layer with furring strips



2 layers of overlapping 4" EPS foam on wall, 10" total on slab edge

2 layers of 4" EPS foam were used in this application. Overlapped on all seams, filled in with spray can foam between pieces. Layer one layer two with furring strips. Now cold climate is recommending the Drain wrap over the bituthene or just Drain wrap only. No stucco used here. There is a big air gap behind the siding.

REMOTE House in Fairbanks



Remote style construction benefits are great as cantilever floors, dormers, gables are finally easy to insulated to the amount needed. No more drafts at your feet. Houses like these are not only energy efficient but they are very comfortable to live in.

Exterior Connections

Exterior structures



Trace stud measurement



It is fairly simple to find studs on new construction

Attaching Furring Strips for Siding

...Is Fun!



The furring strips are installed with 10" screws using the furring strip as a washer.

If not using furring strips when attaching the final layer of foam board, use large plastic washers and screws at least one inch longer than the total thickness of all foam board layers. The furring strips are installed with 10" screws using the furring strip as a washer. The furring strip is treated $\frac{1}{2}$ " plywood attached at base of sill plate and at top by Simpson ties.

Wall Siding, Corners and Trim



Genstone is easy to work with. Ledger detail and corner trim are cut. Ledger is pre-cut. Wide corner trim is not. Big structural screws hold the furring strips on (drilled at an angle, refer to manual) and then the rest of the furring strips hold up the siding and act as a air space for drying.

Siding

Genstone and Cement Board



Protect foam w/ flashing



Pick material NOT frost susceptible for backfill

Metal Flashing Pick material that are not frost susceptible

Windows Exterior

Cement Board for Inset window buck



Proper Flashing is important

Windows Interior

Flashing wraps around interior of sill whether it is an inset window or exterior mounted one. Make sure you leave a foam-able gap around rough opening of window.



Flashing wraps around interior of sill whether it is an inset window or exterior mounted one. Make sure you leave a foamable gap around rough opening of window.

Build it...Raise it



- REMOTE can easily be built on deck to save time.
- Connectable Tabs of membrane must be kept to make connections on corners, sills and top plates.



Inset Door and Window Sills



Inset style reduces heat loss and H₂O that hits window

In our location we have noticed less water running down window when they are inset. (except if wind driven rain, it won't matter anyway)



Exterior Water Faucet Detail



In our application, the Gen Stone lent itself well to carving out flat spaces for mounting electrical boxes, water faucets and other misc. details. It is very firm and strong. After mounting, foam was sprayed into the hole and sealant was applied at opening. Inside view and outside view

Reduce Thermal Bridging

- Before



Following this the screw will be covered in foam. It seems to make quite a difference if it is sealed first.

Important Notes

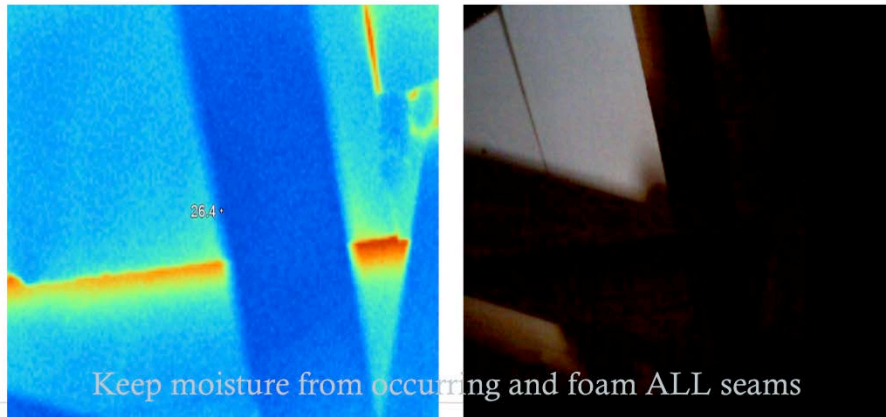
- *The key to the REMOTE Wall System is moving the dew point in the wall to the cold side of the wall (exterior).*
- *REMOTE or OUTSIDE INSULATION TECHNIQUES reduce or eliminate thermal bridging which leads to heat loss and possible moisture problems in the future.*

If done properly. There could be some issues with the recent energy upgrades done with rebate program...interior vapor barriers with foam on the outside? How much? Where is the dewpoint? How much foam should you add to the outside of your studs?

Dew Point Calculator	
Indoor Temperature Fahrenheit	70
Indoor Temperature in Celsius	21.11
Relative Humidity Percentage	40.00
Temperature of dew point Celsius	6.91
Temperature of dew point Fahrenheit	44.44
Air Vapor Retarder Placement Calculator	
Community	Michigan LEAP
Minimum January Temperature	9.3
Total R-Value of Assembly	23.31
Vapor retarder R-Value provided from warm in winter side of wall	9.81
Percentage of R-Value inside Vapor retarder	42.10%
Material Properties	
Material	R-Value
1. Gypsum board	0.06
2. Polyisocyanurate	5.00
3. Gypsum board	0.06
4. Concrete	0.08
5. Gypsum board	0.06
6. Polyisocyanurate	5.00
7. Gypsum board	0.06
8. Concrete	0.08
9. Gypsum board	0.06
10. Polyisocyanurate	5.00
11. Gypsum board	0.06
12. Concrete	0.08
13. Gypsum board	0.06
14. Polyisocyanurate	5.00
15. Gypsum board	0.06
16. Concrete	0.08
17. Gypsum board	0.06
18. Polyisocyanurate	5.00
19. Gypsum board	0.06
20. Concrete	0.08
21. Gypsum board	0.06
22. Polyisocyanurate	5.00
23. Gypsum board	0.06
24. Concrete	0.08
25. Gypsum board	0.06
26. Polyisocyanurate	5.00
27. Gypsum board	0.06
28. Concrete	0.08
29. Gypsum board	0.06
30. Polyisocyanurate	5.00
31. Gypsum board	0.06
32. Concrete	0.08
33. Gypsum board	0.06
34. Polyisocyanurate	5.00
35. Gypsum board	0.06
36. Concrete	0.08
37. Gypsum board	0.06
38. Polyisocyanurate	5.00
39. Gypsum board	0.06
40. Concrete	0.08
41. Gypsum board	0.06
42. Polyisocyanurate	5.00
43. Gypsum board	0.06
44. Concrete	0.08
45. Gypsum board	0.06
46. Polyisocyanurate	5.00
47. Gypsum board	0.06
48. Concrete	0.08
49. Gypsum board	0.06
50. Polyisocyanurate	5.00
51. Gypsum board	0.06
52. Concrete	0.08
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56. Concrete	0.08
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72. Concrete	0.08
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74. Polyisocyanurate	5.00
75. Gypsum board	0.06
76. Concrete	0.08
77. Gypsum board	0.06
78. Polyisocyanurate	5.00
79. Gypsum board	0.06
80. Concrete	0.08
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84. Concrete	0.08
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86. Polyisocyanurate	5.00
87. Gypsum board	0.06
88. Concrete	0.08
89. Gypsum board	0.06
90. Polyisocyanurate	5.00
91. Gypsum board	0.06
92. Concrete	0.08
93. Gypsum board	0.06
94. Polyisocyanurate	5.00
95. Gypsum board	0.06
96. Concrete	0.08
97. Gypsum board	0.06
98. Polyisocyanurate	5.00
99. Gypsum board	0.06
100. Concrete	0.08

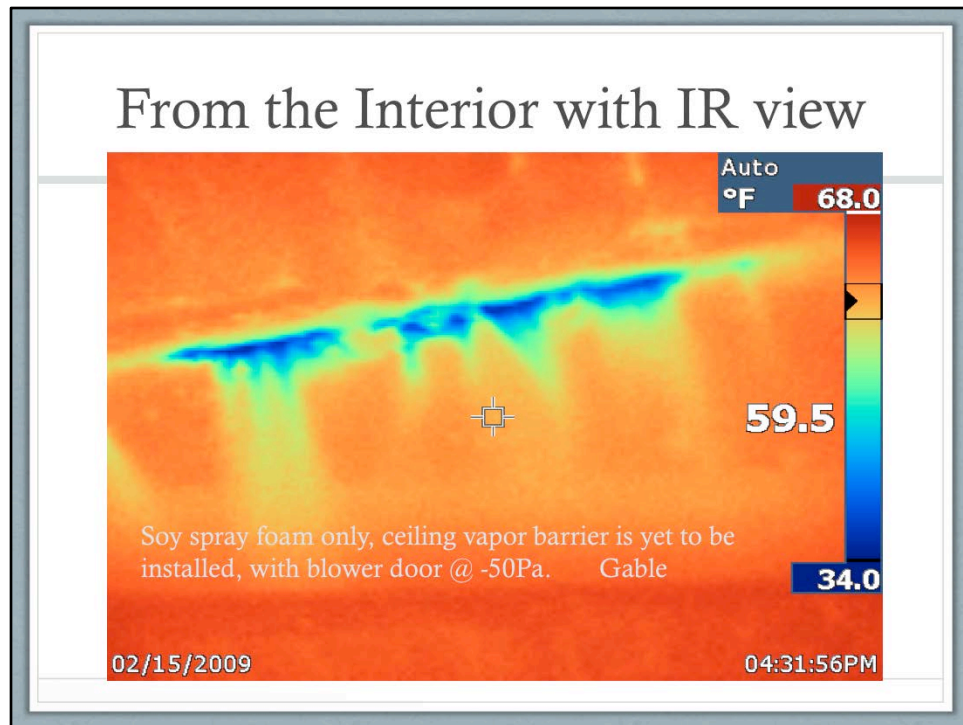
Bridge the Gap!

From the attic



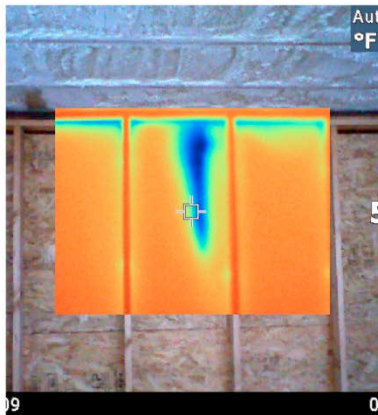
Keep moisture from occurring and foam ALL seams

This is looking in from the attic where the scissor truss and attic truss meet creating a gable end. This is before the vapor barrier is installed and foam has not been sealed with a spray can foam gun.



On Gable end interior to scissor prior to ceiling vapor barrier installation. Soy spray foam only.

Gaps and Goofs



- One layer of 4" foam on unfinished north wall @ -10F.
- Gap is not yet foamed.
- Temperature difference is 30+degrees!
- FOAM THE GAP 😊

This is in part why in the past panel systems have failed. Standard construction can have the same consequence it is just faster when in house is tighter.

Gable Vapor Barrier

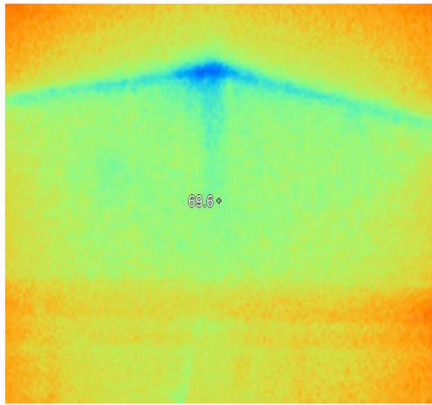
Same area now completed with ceiling vapor barrier



IR picture to follow. Gap was sealed with foam before adding attic insulation.

IR Image of Gable End

Gable after attic insulation



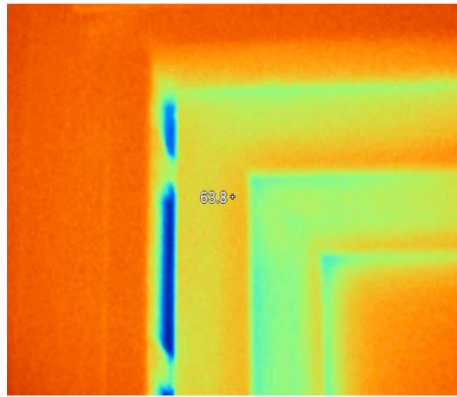
Visual reference



After adding cellulose to attic. R-76 plus 4" foam (soy) and

IR Image of Door Rough Opening

Foam not installed around door



Visible reference

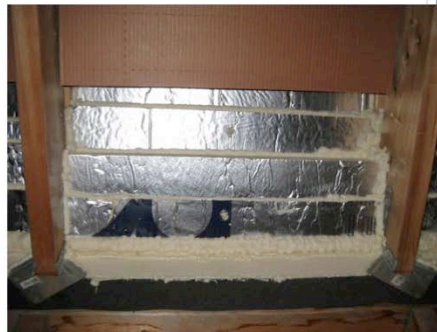


Prior to Foam Sprayed in Ceiling

Adding R-value to top plate



Staggered R-Max



Due to a goof, R-max had to be added into the top plate, baffles were made from it so that desired r-value could be reached. Actually worked very well as the top plate can be a weak link in transitions to the outside. Manual shows instruction for matching truss sizes.

Bio-Based 501 Soy foam

Baffles installed



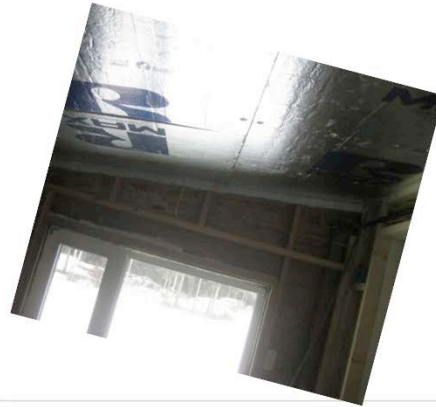
Foam spray of 4", then cut



Foam can be sprayed at very low temps. It was -31 at the time, house was being heated with no attic insulation. As soon as foam was sprayed home was 70* F.

Cathedral Un-vented Ceiling

R-Max is added as interior rigid sheathing insulation to stop thermal bridging



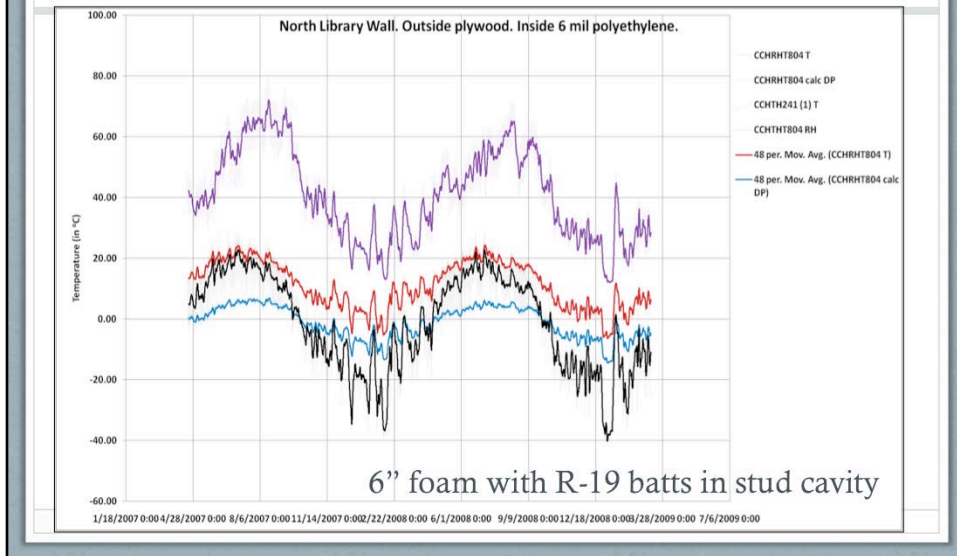
Attic Insulation

Cellulose in attic over 4" soy foam



Venting is minimal due to wind and hoar frost. At 30-50 CFM (for 1200 sq. ft.) of leakage it should not be a problem. $R-76 + SOY (15.2) = 91.2$

CCHRC Wall Sensors @ -40 on test wall of REMOTE



Exterior of plywood but behind poly. All graphs are tracking – come close but never hit dew point.

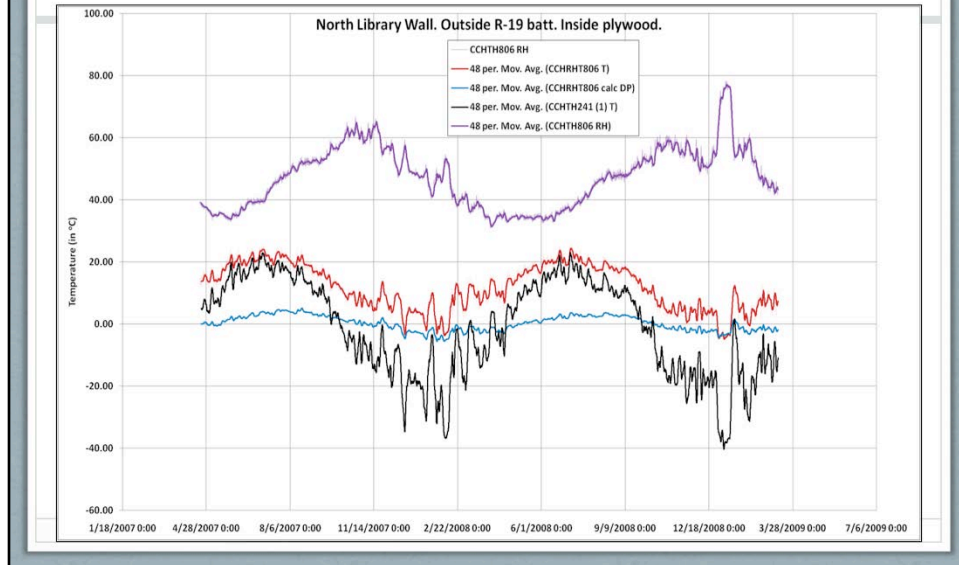
Black – Temperature outside of wall behind stucco

Blue calculated dew point

Red – Temperature at sensor

Purple – Relative humidity at sensor

CCHRC 6" Foam;R-19 in Cavity



Inside plywood. Note humidity spike directly after cold snap & dew point was reached inside wall

Keep in mind this is humidity at sensor, relative to temp at sensor – air can hold less humidity than interior

Air flow reduced Winter very dry in combination with HRV system helps balance

Framing is hygroscopic and can absorb some moisture before saturation

Basic Health and Safety Information

Clean Ventilation is a MUST in
New Construction in
Alaska . . .

And in most of existing homes too

Do you really want to breathe the air from your crawlspace, attic or interior partition wall? Ventilation is an integral part of the house as a system in Alaska. If you are building an energy efficient home, ventilation is critical to your health and well being as well as the longevity of your building.

REMOTE or any airtight building

- The air tightness of the REMOTE shell creates a very tight envelope;
- This can dramatically increase the efficiency of the ventilation system.
- It can also create building pressure issues.
- Sealed combustion appliances in living area must be required, or...
- Adequate pressure relief make-up air must be provided.



Combustion safety is important with any house system. In Alaska our homes are more airtight than almost anywhere else. On a monthly basis home(s) are found with back drafting appliances during a worst case depressurization test. More Alaskans should look toward properly ventilating their homes after a thorough energy audit.

Health and Safety

Heating System Safety

- Draft
- Carbon Monoxide
- Fuel Leaks
- Clearance to Combustibles



Moisture-Related Health Hazards

- Mold
- Mildew
- Fungi



Ventilation/Fresh Air Exchange Issues



Moisture and Your Health

- High humidity
 - Encourages mold and mildew growth
 - Increases growth of fungi and dust mites
 - Can worsen the effects of chemical contaminants

Ventilation is needed in a majority of homes in alaska. Radon is found in 1 out of every 5 homes in Alaska.

Indoor Air Quality

What is living in our house with us?

**How do we feel when we spend
time in our house ?**

How do we use the tools in our home?



How do we feel when we spend time in our house ?
How do we use the tools in our home?
Sometimes we know the least about the place we call our haven!

Ventilation Without Heat Recovery



Ventilation With Heat Recovery



HRV –heat recovery ventilation

Introducing the SmartExhaust™

BATH FAN/ LIGHT SWITCH/DELAY TIMER/VENTILATION CONTROLLER

Take Control of the Bathroom Fan: Light Switch, Bath Fan Switch, Fan Delay Timer & Ventilation Controller ... All in a Single Switch!



- ◆ Make standard bath fans ASHRAE 62.2 compliant
- ◆ Microprocessor technology provides precise ventilation times.
- ◆ Manual fan operation is subtracted from set ventilation time.
- ◆ Fan runs every hour for set ventilation, less any manual and delay operation.
- ◆ Excess manual and/or delay operation is subtracted from next hours ventilation time.
- ◆ Great for - Meeting ventilation codes, Reducing Mold, Mildew & Pollutants, Saving energy and you money!

The new SmartExhaust™, from the same people who brought you the AirCycler line of ventilation controllers, introduces a simple, smart, flexible and economic solution for exhaust ventilation requirements.

The SmartExhaust™ is designed as a replacement for the bathroom fan and light switch. By using a microprocessor to monitor and control fan operation, a precise amount of ventilation can be provided.

Switch On: Light & Fan turn on... Switch Off: Light turns off, Fan remains on for set delay time. Off-On-Off fan goes off.

There are only two settings on the SmartExhaust™ switch - Ventilation and Delay. Ventilation is the minutes per hour that you want the fan to operate. Delay is the number of minutes you want the fan to run after the bathroom light has been turned off. The Delay time provides additional run time of the fan to complete ventilating the bathroom after use. The SmartExhaust™ is so smart, you can tell it you don't need the fan to run when you leave the bathroom. When you turn off the light, turn it back on then back off again within a few seconds it tells the SmartExhaust™ you don't want the fan to continue running.

Since you are substituting an existing switch, or maybe even two, there are no additional labor costs to the SmartExhaust™ installation. With the light and fan being the same switch, the ventilation strategy can't be defeated.

It's simple, it's smart, it's easy...
The Most Economical Ventilation Solution!

Patent Pending Cover plate not included. Use any standard switch plate.



Set the Ventilation & delay times from 0-60 minutes.



SmartExhaust™ Specs:
Light: 450 Watts @ 120 VAC
(Blue wire)
Fan: 150 Watts @ 120 VAC
(Red wire)
Operations: 120VAC ± 10%
50/60 Hz

AirCycler
www.AirCycler.com
AirCycler a Division of Updex Corporation
411 Plain Street, Marshfield, MA 02050

For more information call:
1-877-3AN-CONTROL
(1-877-326-2668)
www.aircycler.com

Outside Insulation Technique...

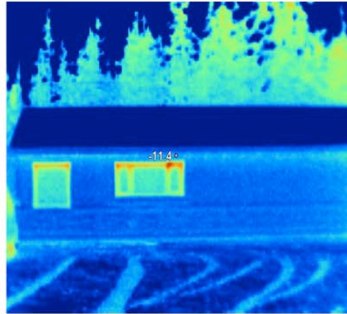


Read the manual carefully, use the charts and build it right.

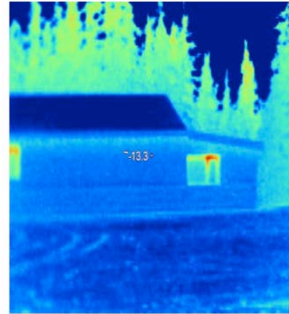
Read the manual carefully and use the charts and do it the right way.

Exterior IR view at -15

HRV not installed, window open in kitchen



Add-on connection, wall, foundation and roof show little heat loss







Co
mfor
t...
at
last

LINKS



www.cchrc.org
(907) 457-3454

New River Center for Energy
Research and Training

www.nrcert.org
540-381-9446

Wisdom and Associates, Inc.
www.wisdomandassociates.com
907-283-0629

LINKS

Wisdom and Associates: Thanks for the charts, please check out their website it has a wealth of information.

CCHRC.org for more information. Special thanks to Anthony Cox and the New River Center for Energy Research and Training.