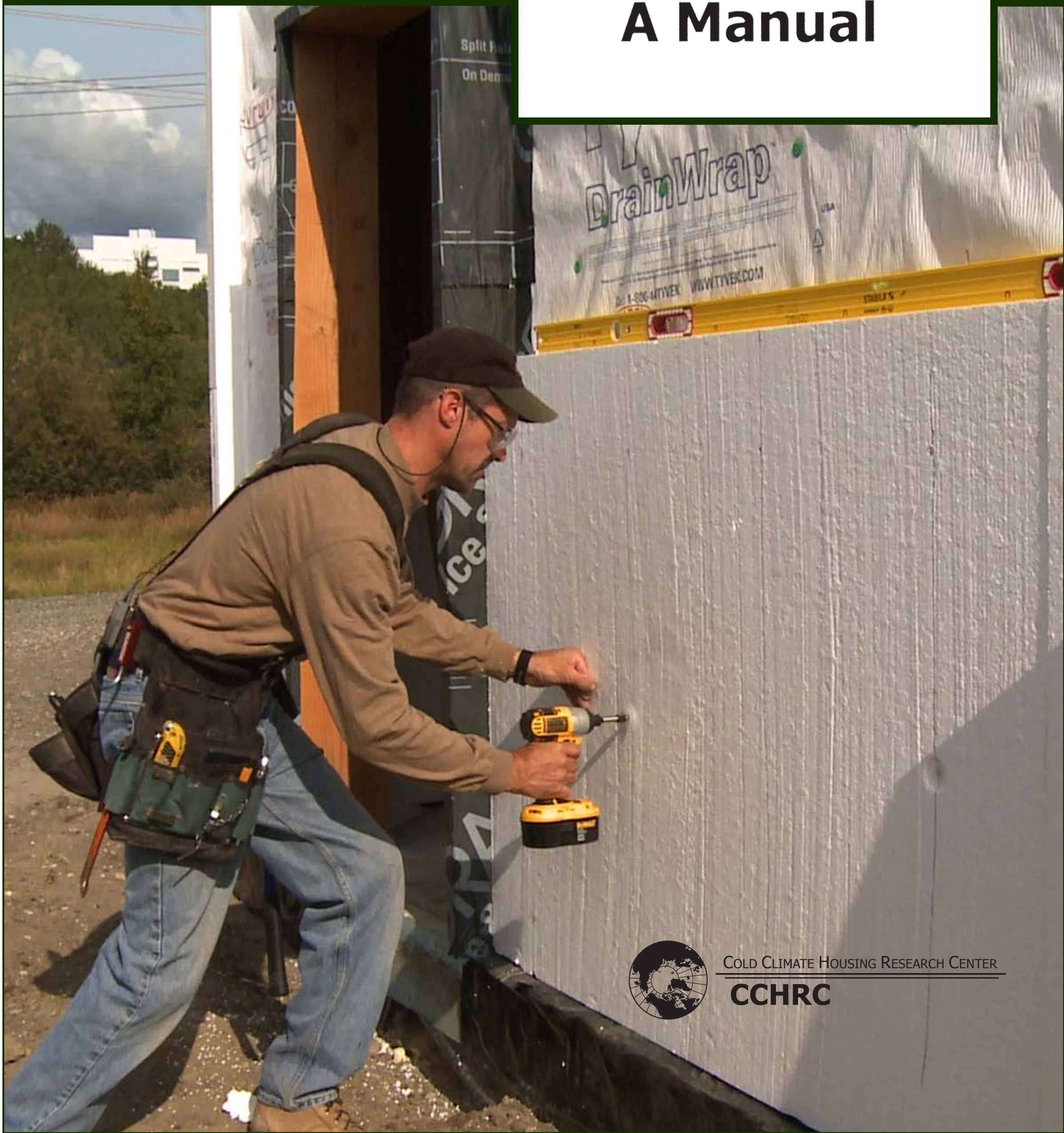
REMOTE

A Manual



COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC

The REMOTE Wall System described in this manual is an outside insulation technique using rigid foam board. It is the culmination of many years and creative force of home builders, researchers and home-owners throughout the North. The basic concept was derived from a Canadian engineer, Max Baker, who first pioneered outside insulation in the 1950s. Over the past 10 years we have researched and collaborated with partners on various projects to study the REMOTE wall system, and and refine the construction techniques that work best in the Circumpolar North's varied, and often harsh, climates.

This manual is a detailed guide for the REMOTE Wall system. However, it is just the beginning of what we hope will be a vigorous and productive conversation about one of the most important subjects affecting the quality of life in our world today—safe, energy-efficient shelter.

We encourage you to use this manual as a guide, and to bring to it your own experiences, skills and knowledge. Above all, we hope you will join us in the conversation about how to improve on it.

***Jack Hébert**, President/CEO, CCHRC and owner of Hébert Homes/Taiga Woodcraft*

PLEASE NOTE:

As with all complicated projects, there are many elements to consider and many available products. We strongly urge you to research products, codes and climatic effects prior to building.

This publication provides only general guidelines for the REMOTE Wall System.

And as with any building project, check your local, county, state and national building and safety codes before beginning construction. If you are building in an area with local codes, they may have amendments that will take precedence over national code. In Alaska, the Alaska Housing Finance Corporation Building Energy Efficiency Standard (BEES) has been amended and must be complied with in order to qualify for the state-sponsored Home Energy Rating Program and its associated incentives. This includes higher minimum insulation requirements and changes in ventilation standards over national code. These amendments can be found at: http://www.ahfc.state.ak.us/iceimages/reference/bees_amendments.pdf.

This document is a work in progress and we will publish updates as needed. If you wish to be notified of new editions, please forward your email address or other contact information to: info@cchrc.org. We will continue to publish this manual on our website, where it can be downloaded for free.

Thank you to our reviewers

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Remote, A Manual was produced by the Cold Climate Housing Research Center, July 2009.
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REMOTE Wall System Overview

Conventional wall construction methods may be less expensive initially, but in the long term can result in higher heating costs and lead to moisture management problems. Cold climate construction techniques must address four issues successfully: moisture control, air tightness, air quality, and adequate insulation.

The Moisture issue.

Control of moisture is one of the biggest challenges of home building in cold climates. This moisture can originate from the interior due to cooking, bathing, plants and many other sources. Moisture can also originate from the exterior from precipitation that leaks past the siding or from soil moisture that is drawn into below-grade assemblies.

From the Inside

Setting aside obvious faults such as plumbing leaks, the primary sources of moisture inside the home occur naturally from occupants in the form of water vapor. This water vapor must be prevented from escaping into the building shell. There are two primary mechanisms by which moisture from interior water vapor can migrate into the shell: air transport (leakage) and diffusion. It is generally accepted that of the two mechanisms, air leakage is of primary concern. Two conditions must exist for air leakage to take place: you must have both a driving force and a leakage pathway. The driving force is virtually always present, as it is provided by air pressure differences between the interior and exterior due to stack effect, wind, and mechanical systems such as exhaust fans. As a result, controlling air leakage must be primarily accomplished through construction techniques to minimize holes in the envelope. Conventional vapor retarder and air barrier systems can fail in cold climates due to imperfect sealing. Any penetrations - such as those caused by electrical outlets, fasteners, or vents - create vulnerabilities if they are not detailed meticulously.

From the Outside

Alaska's coastal climates encounter a phenomenal amount of precipitation, often accompanied by winds that can force moisture into the building shell. When a weather resistive barrier is placed immediately behind the siding without an air gap to promote drying, it's effectiveness and lifespan may be reduced. Even if the framing is protected from liquid water, moisture absorbed in siding can diffuse inward from solar heating. This can create vapor pressure differentials across the building envelope even greater than those produced by dry, arctic winter conditions where the vapor drive occurs predominantly from the interior.

If the wetting of wood framing occurs frequently and over a long enough time period, mold and rot can develop inside the building envelope. Mold growth can cause poor indoor air quality, and rot can lead to structural problems.

The Insulation issue.

Exterior walls comprise the largest surface area of the building shell in a typical home. As a consequence, an under-performing wall system is often responsible for a majority of space heating costs. High fuel prices have shown that in cold climates 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. Voids, compression, and air leakage (even if minor in appearance) can have a dramatic effect on insulation performance. 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.

One Solution.

The REMOTE Wall System (**R**esidential **E**xterior **M**embrane **O**utside insulation **TE**chnique) provides a superior alternative that integrates standard frame construction with high insulation values and moisture control (Figure 1). This system has been tested extensively in Interior Alaska by the Cold Climate Housing Research Center (CCHRC) in Fairbanks, and Maritime Southeast Alaska as a partnership between CCHRC and the University of Alaska Southeast Construction Technology Program in Juneau.

How REMOTE works.

Instead of relying on interior vapor retarders placed behind drywall, the REMOTE Wall System locates an air and/or vapor retarder (“exterior membrane”) on the exterior of the house, over the sheathing. The bulk of the wall insulation is provided by rigid foam boards, which are attached to the outside of the structure over the exterior membrane. The goal of this approach is to move the dew point out from within the stud bays and to the exterior side of the sheathing, thus preventing framing members from cooling to the point that condensation can occur.

Advantages.

The REMOTE system has several advantages. When properly constructed, it creates a super-insulated wall that effectively eliminates thermal bridging and air movement. The wall cavities can dry to the inside if any wetting events occur or if the framing lumber is not dry before use. Exterior walls, which are a traditional freezing danger zone, are now available to run plumbing and mechanical systems with much less risk. Less expensive 2x4 construction is a viable option because the stud bays no longer need to hold large amounts of insulation. The system protects structural members and is durable.

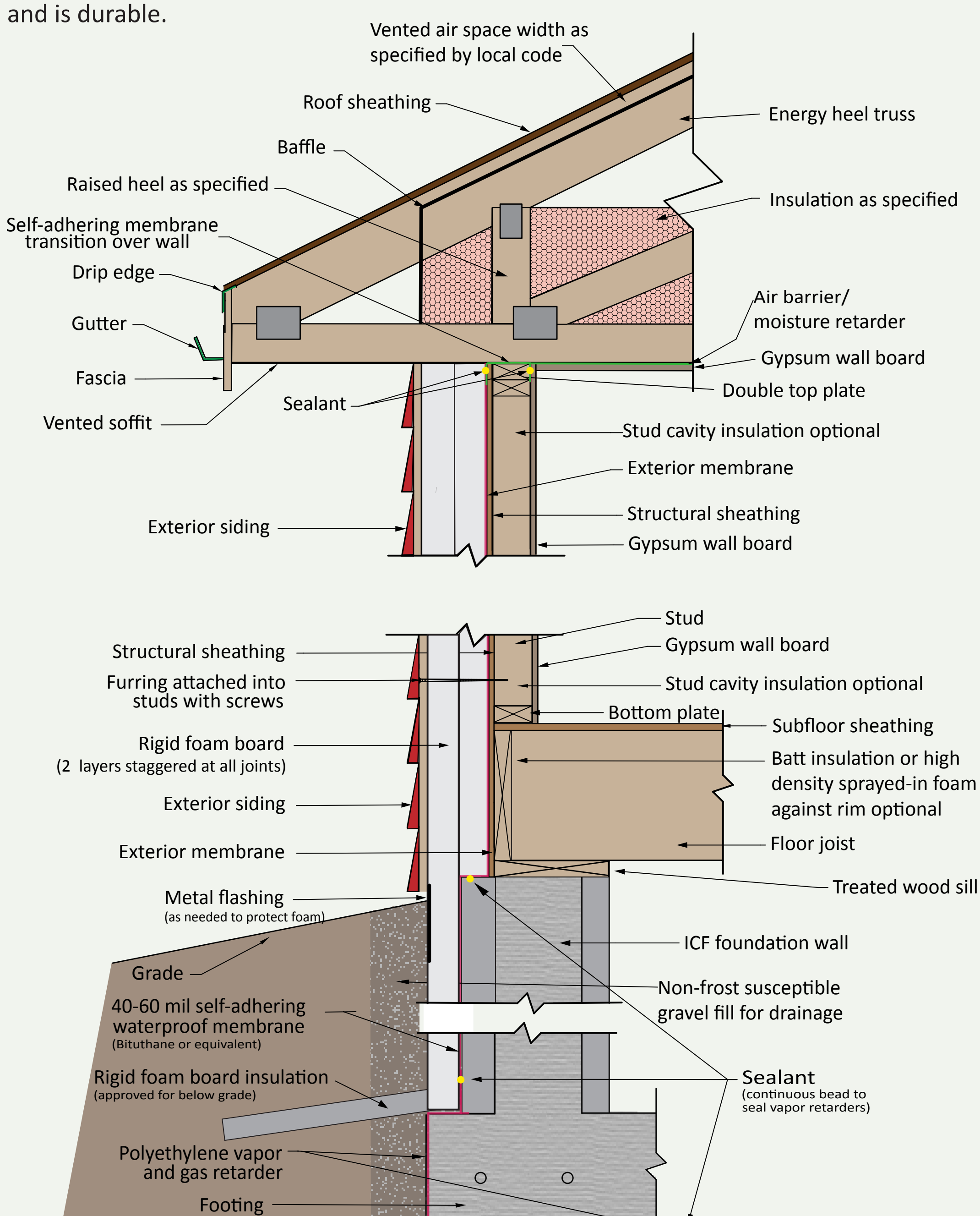

Figure 1. WALL CROSS SECTION of 2x4 REMOTE WALL

Framing

Overview

The REMOTE system employs standard framing methods with a few notable exceptions.

Framing and Furring layout.

Because the exterior furring must support siding, vertical furring should line up directly on the studs. Consequently, if the siding allows for a maximum of 16 inch on-center attachments, the structure should be framed accordingly. The location of windows and doors near corners will be affected by the additional thickness of the exterior insulation. One popular option is to use 2x6 framing with studs placed two feet on center. This approach yields a deeper stud cavity to run mechanical systems, particularly heat recovery ventilator (HRV) ducts, and meets code for spacing in two-story structures where the walls are supporting a floor, roof, and ceiling. Two feet on center is also the maximum stud spacing for 0.5 inch sheetrock as specified by 2006 International Residential Code R602.3(5). It is considered good practice to line up ("stack") all studs between floors, along with the joists and trusses. This approach can save on lumber, lines up the load paths in the framing, and keeps the stud and joist bays in line with each other between the floors to more efficiently run ducting.

Exterior foam board and Truss Intersections.

Truss design and the desired amount of attic insulation should be determined before framing begins. Wall insulation and attic insulation must meet in the same place and in the same plane in order to maintain a continuous thermal barrier. This can be accomplished by either extending the attic insulation out over the top of the wall to line up flush with the wall insulation (Figure 2), or extending the wall insulation up into the truss bays high enough to be level with the top of the attic insulation (Figure 3). Plan your interior and exterior insulation strategy around your truss choice (Figures 2 and 3). A continuous thermal boundary is critical to have continuous coverage where the outside walls transition to the truss bays.

Truss choice and insulation strategy also depend on your blocking options. Building codes typically require blocking, placed between the trusses and securely nailed directly over the double top plate in order to meet shear requirements. This means that any insulation in the attic is forced to end at the blocking, leaving the area directly outside the blocking exposed. There are several options here that can be presented to an inspector:

- Solid blocking can be installed between the trusses and fastened directly into the double top plate, as is traditional. This will require the exterior wall foam boards to be cut and fitted between the truss tails to the height of the ceiling insulation.
- If the code allows, diagonal bracing can be substituted for solid blocking directly over the walls. A baffle can then be added to the exterior side of the blocking in plane with the outside of the wall foam board. This way attic insulation can be blown between the braces from inside the attic, all the way out flush to the exterior of the wall (Figure 2).
- A raised heel truss can accomodate large amounts of insulation depending on the height of the heel. If the bottom chord of the truss ends at the exterior of the wall, then the wall sheathing can be continued up the heel of the truss until it hits the top chord which can also strengthen the blocking in this area. See Figure 3 and Images 1 and 2.
- To adjust for the added thickness of the wall insulation, truss tails should be ordered longer than usual, i.e., a wall with a two foot truss tail and six inches of exterior foam board will have a visible overhang of slightly less than 18 inches. If a two foot finished overhang is desired, then the tail should be ordered at least two feet, six inches.

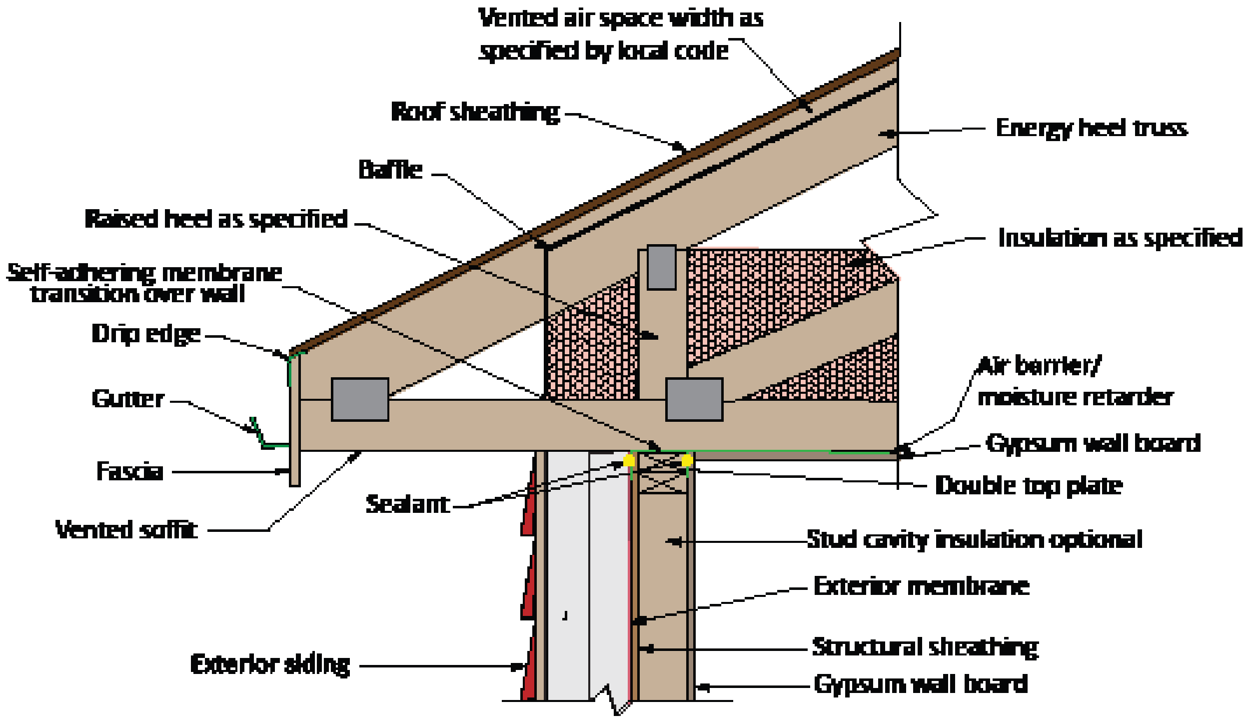

Figure 2. BRACING WITH ROOF INSULATION OVER WALL INSULATION

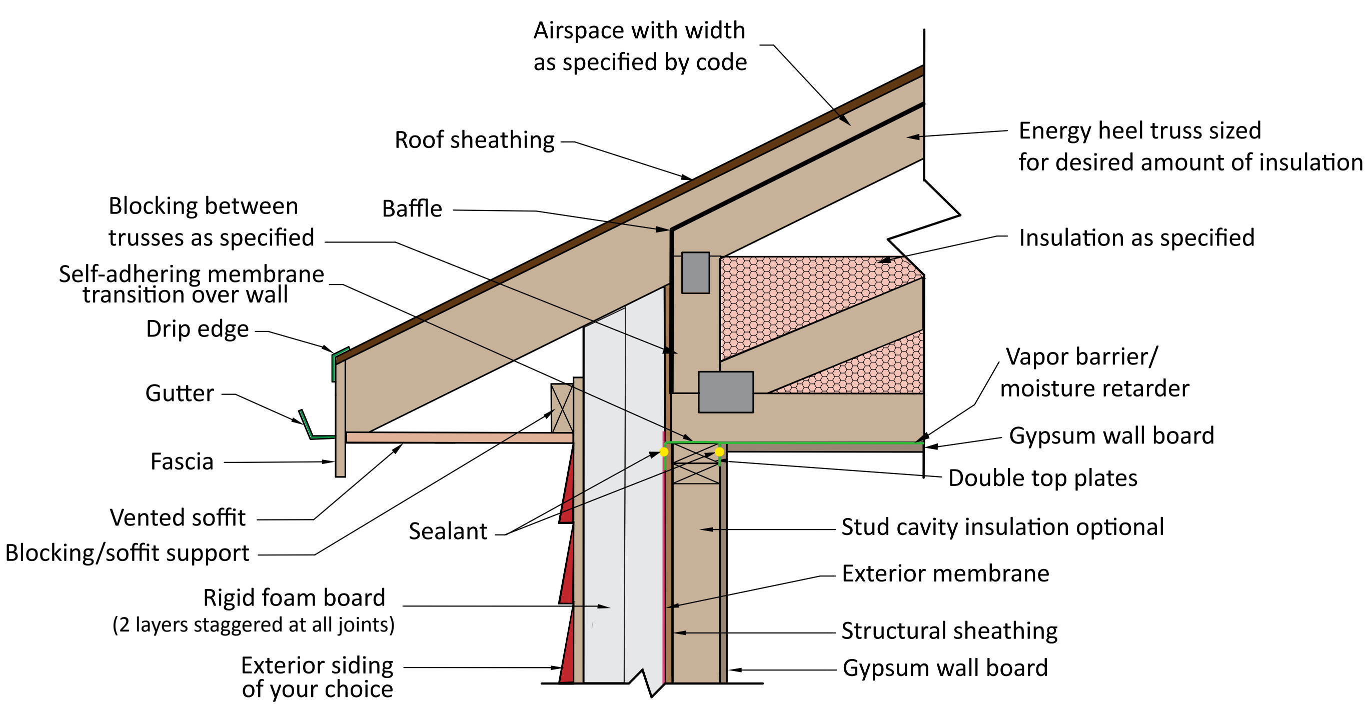

Figure 3. BRACING WITH ROOF INSULATION ABUTTING TOP CHORD, DEEPER ENERGY HEEL TRUSS

Framing

Thorsten Chlupp

Image 1. *Exterior View:* 18-inch-deep energy heel truss allows for R-60 roof insulaton and easy continuation of wall foam to the top of the attic insulation

Thorsten Chlupp

Image 2. *Interior View:* 18-inch-deep energy heel truss allows for R-60 roof insulaton and easy continuation of wall foam to the top of the attic insulation

Wall Framing

Summary and Installation Tips

- Standard ICC and other building codes apply to this wall technique. Check before you build!
- Either 2x4 or 2x6 framing works with this system.
- Layout for windows and doors may be affected by the extra thickness of the exterior insulation, so plan ahead.
- Exterior walls are available to safely run most mechanical and plumbing systems.

Roof Trusses

Summary and Installation Tips

- Determine what approach will be used to provide truss blocking before ordering trusses. This may require reviewing building codes or consulting an engineer.
- Select your truss option early in the project so that the purchase of other materials can be planned around the truss system.
- Ensuring continuous coverage of insulation between and around trusses is critical to energy savings.
- Factor in the amount of visible overhang that will be lost by the thickness of the exterior foam and order longer truss tails if desired.

Decks and other exterior structures.

Attachment points for decks and other structures that are fastened to exterior walls usually consist of blocks built up to the finished thickness of the foam board rather than continuous ledger boards (Figure 4). This method minimizes the solid wood surface area that can conduct cold to the inside. As in all cases requiring structural loads, an engineer may be required to size the blocking and specify what method and type of attachment must be used. Local code requirements may conflict with this approach and need to be considered early in the design process. Any structural blocking between the studs can be easily installed before walls are sheathed and raised. All metal fasteners that penetrate through the entire wall, from outside to inside, and that are exposed to air in the inside conditioned space, need to be covered with spray foam or a similar material to avoid condensation or icing problems inside the walls (Images 3 through 7).

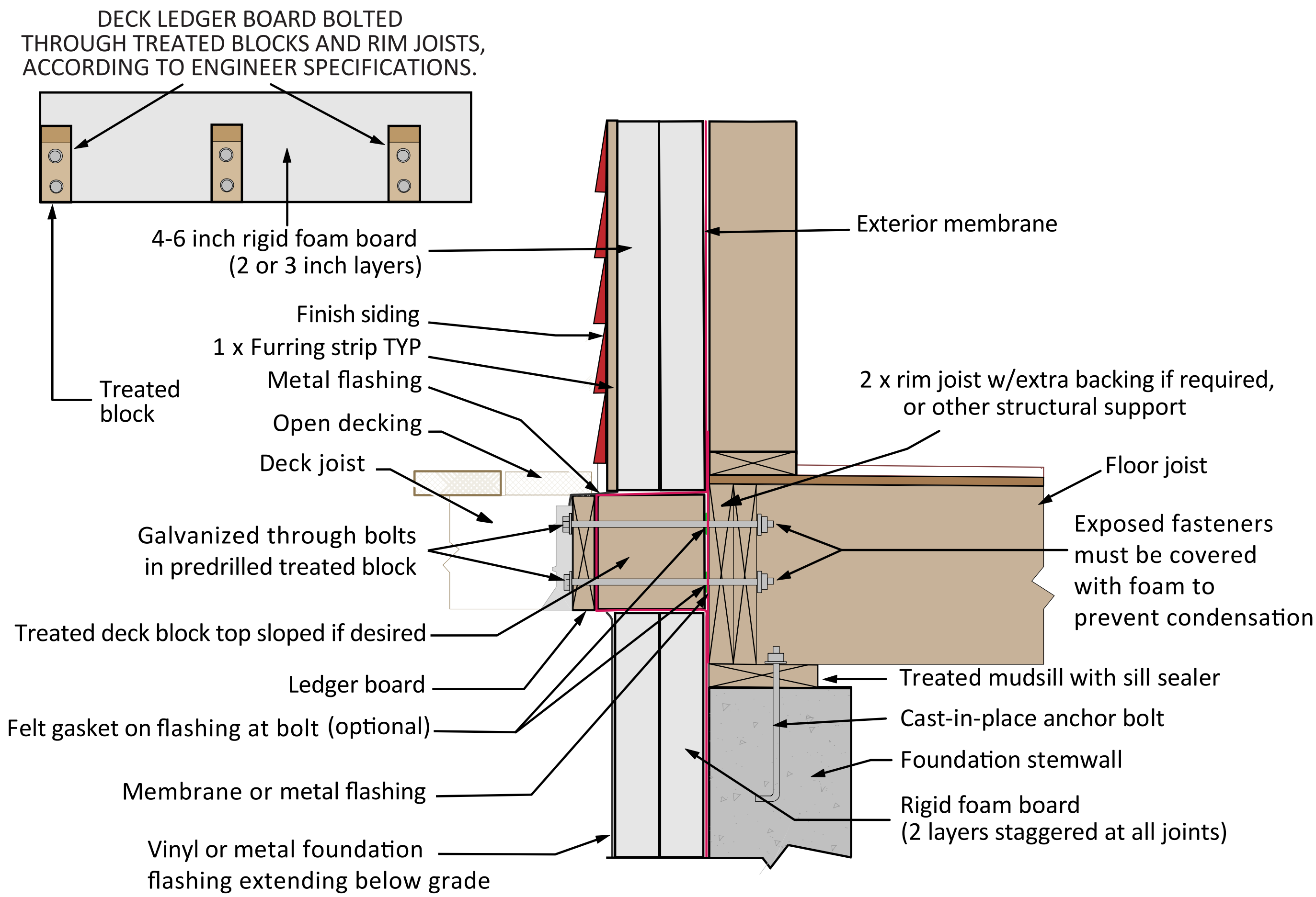

Figure 4. MOUNTING DECKS AND OTHER EXTERIOR STRUCTURES

Thorsten Chlupp

Image 3. Deck blocking over 6-mil polyethylene

Jack Hébert

Image 4. Insulating deck fastener penetrations on interior to prevent condensation

Jack Hébert

Image 5. Installed foam between cantilevered joists

Framing

Image 6. Deck blocking and ledger board

Thorsten Chlupp

Image 7. Deck framing

Decks

Summary and Installation Tips

- For the best thermal performance, deck attachment points should be blocks, not continuous ledger boards.
- Consult with an engineer for block and load-bearing calculations.
- Structural blocking between the studs, as needed to support decks and roofs, can often be more easily installed before the walls are sheathed and raised.
- Any fasteners that extend from the exterior through the wall, and that are exposed inside the stud bays, should be covered with foam insulation to avoid condensation or icing problems inside the wall (Image 33).

Overview

A REMOTE wall is much thicker than a conventional wall due to the multiple layers of exterior foam board. This results in very deep window and door wells. Two ways to deal with these deeper wells depend upon the given climate and desired outcome: mount the window flush to the exterior foam board, or inset the window and mount it on the sheathing behind the foam board. Both methods assume flange-mounted windows will be used as they are more prevalent and tend to be easier to install and flash. Windows without flanges are certainly viable, but detailing methods will be different. In most installations, the inclusion of a foam backer rod, caulked in place as necessary, yields the best results when initially sealing between the framing and the jamb. Spray foam can be used to fill the remaining gap. The backer rod provides the compressive element and the memory to provide a better long term seal. Spray foam alone might not seal adequately, especially if the exterior membrane has been wrapped and stapled into the window well.

Exterior-mounted windows.

In a drier climate, such as Fairbanks, Alaska, the door and window bucks can be sized to extend the entire depth of the wall, thus breaking the drainage plane of the sheathing and the exterior membrane (Figure 5). Proper sizing requires measuring the thickness of the framed wall, sheathing, foam board, and furring. When sizing the jamb extensions that comprise the opening, take the foam board measurement from the actual material to be used—foam board sheets can vary slightly in thickness in different manufacturing runs. One approach is to frame the opening traditionally, but oversize it by 1.5 inches on all sides that will have a jamb extension (Image 8), four sides on a window and three sides on a doorway. After the wall is sheathed and the openings are cut out, the extended window and door bucks can be installed and nailed in place. If the wall is thicker than a 2x12, such as a 2x6 framed wall with six inches of exterior foam board, then the 2x12 extensions are installed to be flush to the finished exterior face to provide secure window/door attachment and sealing. The window bucks can be brought to full depth on the interior side framing with furring strips nailed to the inner edges of the buck. The 1x4 furring is fastened through the foam board in a frame around the buck—not on—to provide for the attachment of siding and trim. There are more creative framing variations that can incorporate the jamb extensions into the trimmers to save on the extra layer of framing lumber. The critical issue is that any load-bearing headers must have the required amount of bearing down to the floor or the bottom plate, and ultimately the foundation.

For an exterior-mounted window, the outer faces of the buck framing that extend past the sheathing are wrapped with a self-adhering flashing that laps back over the wall's exterior membrane (Images 9 through 11). Off-the-shelf products such as DuPont Tyvek® StraightFlash™ are one option. If desired, a sloped sill, i.e., a piece of beveled cedar siding, can be added on top of the box and wrapped as part of the process. This helps direct water that runs down the wall toward the front of the window and away from the vulnerable joint where the buck exits the wall. The adhesive flashing that wraps the buck is trimmed flush inside the window opening to completely seal all exposed wood. This flashing gives the flanges of the window a direct sealing surface to the self-adhering waterproofing membrane. An alternate method is to flash the window box bottom, first creating a waterproof interior sill for about the first four inches or so, then install the window, and finally wrap the flanges with the adhesive membrane.

Exterior-mounted window Pros and Cons.

The advantage to the exterior-mounted window is speed. There is just the inside sill to contend with, as the outside of the window only requires casing and flashing as finish details. This method results in significant labor savings. One disadvantage of this method is that the window is no longer on the same drainage plane as the wall sheathing. The joint where the jamb passes through the sheathing presents a weak spot for water infiltration. Another issue is that the window may stay cooler and be more prone to condensation and frosting on the inside because it is positioned on the outside of the wall. This conclusion is based on anecdotal evidence in 2x6 walls using six inches of foam board during negative forty degree cold spells in Fairbanks, Alaska. Warmer climates and shallower window wells would likely avoid this problem. Weigh both the regional climate and the level of importance placed on good weather sealing when choosing the exterior-mounted window method.

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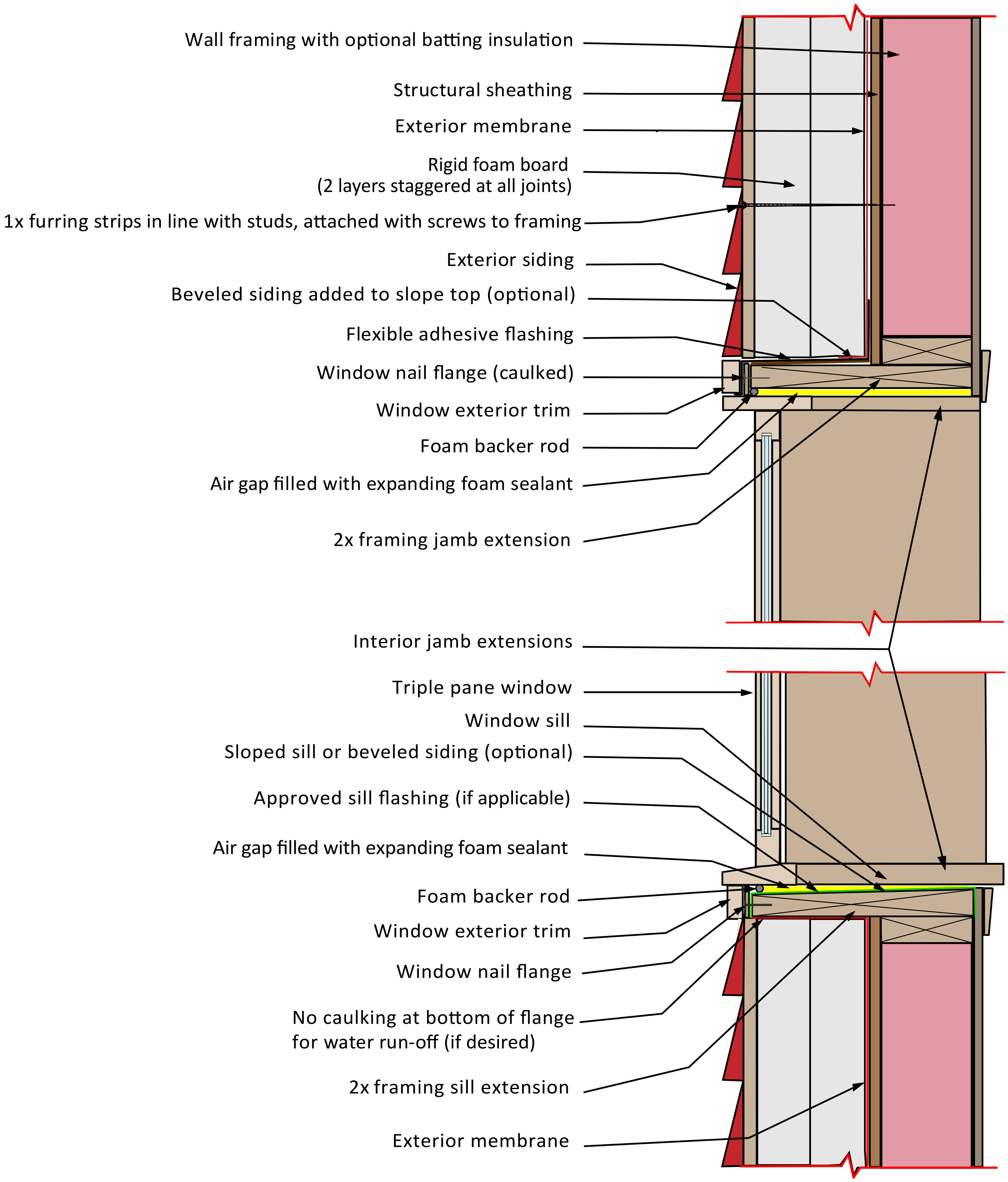


Figure 5. EXTERIOR-MOUNTED WINDOW

Image 8. Tyvek® DrainWrap™ is showing promise as an exterior membrane option, (as pictured here and the following pages on the CCHRC facility). It has met with code approval in areas of southeast Alaska, and its performance during sustained periods of extreme cold continues to be tested in Fairbanks.

Image 9. Window buck sill detail with Tyvek® FlexWrap™

Image 10. Exterior window buck sill corner detail. Tyvek® FlexWrap™ (or similar product) must be stapled arround edges

Image 11. Shingle-style flashing on exterior window buck

Exterior-mounted Windows
Summary and Installation Tips

- Best in a dry climate with infrequent wind-driven rain.

- A foam backer rod, caulked, will ensure a better, more durable seal in the space left around the window on the inside; spray foam can then be used to fill the remaining gaps.

- Have your door and window bucks sized to fit the entire depth of the wall; include the thickness of the framed wall, sheathing, foam, and furring.

- For accurate sizing of window and door bucks, measure the actual foam to be used on the project, as sometimes foam sizes vary slightly from their stated thicknesses.

- If the window buck material is not as deep as the wall, additional thickness can be achieved with furring strips, applied on the interior side of the window buck.

- Load-bearing headers must have the required amount of bearing on the trimmers in order to properly transfer any overhead loads.

- Multiple methods of flashing around the windows will work with this installation.

- Adhesive flashing is preferable to completely seal all wood on the buck. Before applying, check the product literature to make sure different flashing types are chemically compatible.

Inset windows.

In a wet climate, especially where wind-driven rain can drive bulk moisture behind the siding, a continuous drainage plain is a better option (Figure 6). One advantage of a continuous drainage plane is that the door and window openings can be framed and sheathed traditionally. The windows are attached and flashed directly over the sheathing or exterior membrane using standard flashing techniques (Image 13).

Once the wall is framed, the first step is to install the exterior membrane and requisite sill flashings. The flashings typically consist of self-adhering waterproofing membranes and an optional sill pan. If the sill and/or sill flashing are installed before the exterior membrane, the bottom edge should remain unattached to the face of the sheathing so that when the wall's exterior membrane is installed around the window it can slide under the flashing to ensure proper drainage.

The windows are attached by nailing and caulking the flanges along the top and sides to the sheathing or the chosen exterior membrane, depending on the order of events and according to the manufacturer's specifications. In wet climates it may be desirable to omit caulking the bottom flange and slope the sill framing so that any potential water that works its way past the window or the seals can drain back out. This method is by no means the only way to flash a window. The most important thing to be aware of is that water traveling down the wall should always run over the flashing joints, not under, using shingle-style installation methods.

Once the window is installed and the building exterior is completely weatherproofed, a pre-assembled four-sided jamb extension, sized to the finished thickness of the wall, can be fastened in place (Images 12 and 14). Since this window box sits on top of the window flanges and flashings (unlike the earlier method discussed that uses full-depth window bucks), it maintains the drainage plane of the wall. Ideally, the fasteners used to attach the jamb over the window will penetrate through the underlying self-adhering waterproofing flashing membrane. Any water that finds its way behind the jamb or the foam board will hit the drainage plane and be directed downwards via the exterior membrane. This installation method is more tolerant of wet environments. Ideally, the jamb extension will have a beveled bottom sill to direct water away from the window. A piece of beveled siding will also be nailed on top of the box and completely flashed with an adhesive membrane, i.e., Tyvek® FlexWrap™, to keep water from running down the wall and behind the extension. As an alternative to the beveled siding, the top of the window box itself can also be sloped slightly to the front (around 2-5 degrees) to insure water is directed outwards. The jamb extension itself can be built out of finish-grade materials such as cedar, synthetics such as AZEK® trim, or wrapped with a pre-bent metal trim to suit the siding (Image 15). Additionally, for those interested in synthetic stucco, this type of finish requires no jamb extension (Images 16, 17, and 18).

Thorsten Chlupp

Image 12. Vinyl siding around inset window with AZEK® jamb extension

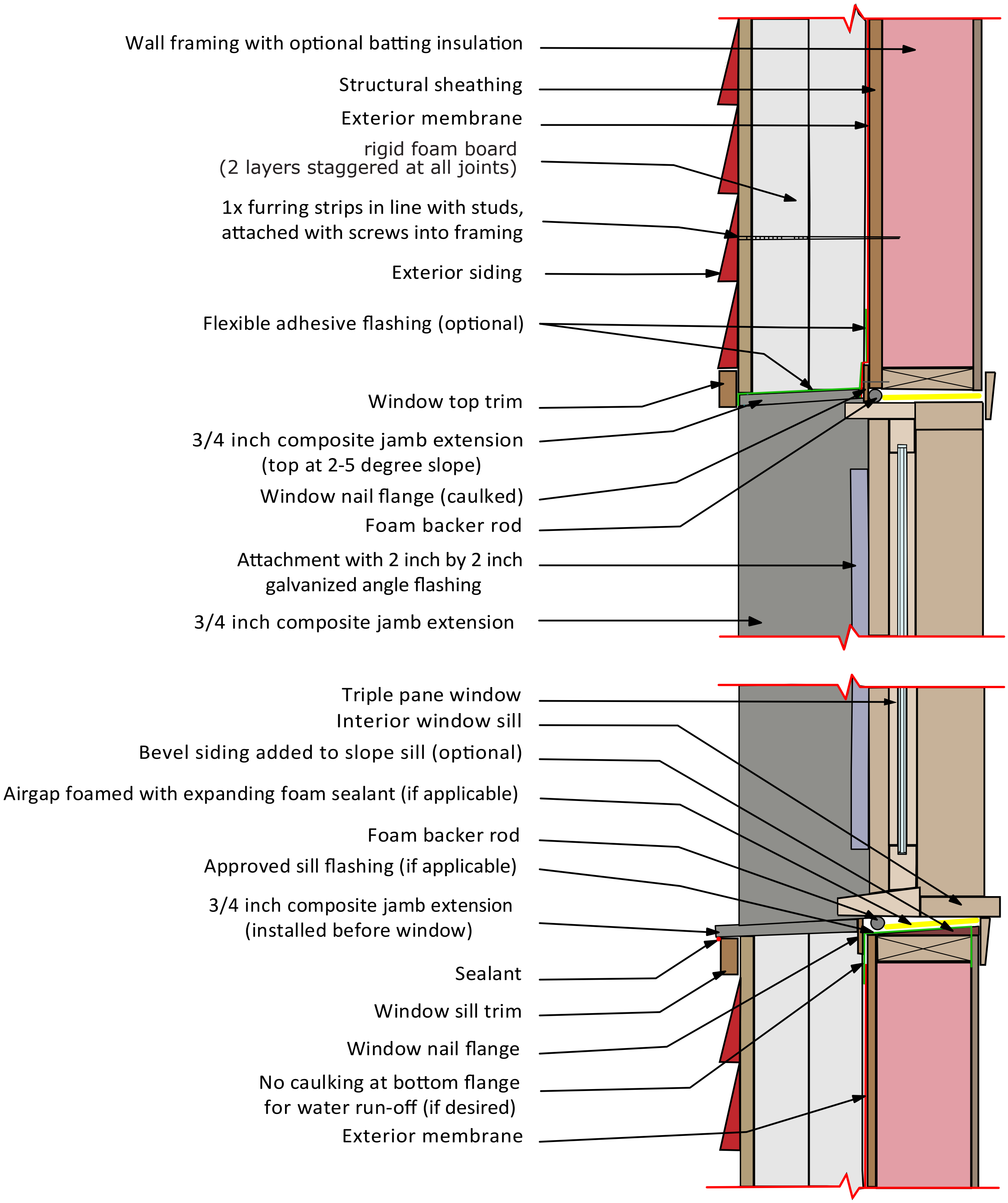


Figure 6. INSET WINDOW

Image 13. Inset window with AZEK® jamb extension, attached to the sheathing using 2 inch x 2 inch light gauge galvanized flashing

Thorsten Chlupp

Image 14. Inset window with AZEK® and first layer of foam

Thorsten Chlupp

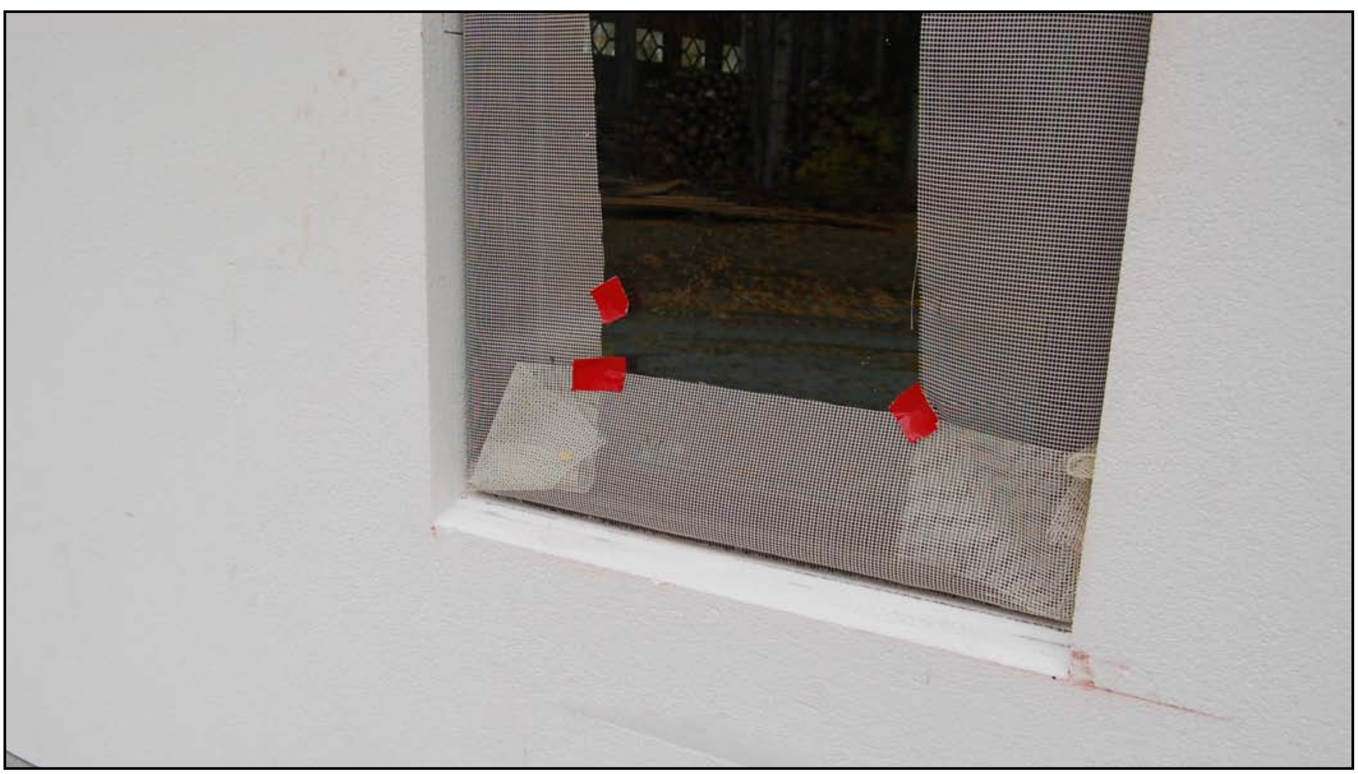
Image 15. Inset window with steel jamb extension

Thorsten Chlupp

Image 16. Inset window with stucco exterior

Mike Musick

Image 17. *Stucco preparation:* Inset window flashing



Mike Musick

Image 18. *Stucco preparation:* fiberglass mesh for corner support is stapled to the framing and wrapped arround the foam

Inset Windows

Summary and Installation Tips

- Best in a climate where moisture and wind-driven rain are frequently present.
- Allows traditional window and door framing.
- Pre-assemble your jamb extensions with beveled bottom and top sills as desired, to save time.
- Less prone to icing in very cold climates because the window is in the middle of the insulated wall where the glass stays warmer.

Overview

Self-adhering waterproofing membranes, i.e., Grace Bituthene®, were used in early REMOTE construction due to their impermeability and ability to seal around fastener penetrations (Image 19). Covering an entire house with these materials is extremely effective but typically more expensive. As an alternative, 6-mil polyethylene sheeting has been used with good results and meets Fairbanks building codes which require the use of a vapor retarder with a permeability (perm) rating of .06 or less. It is worth noting that 6 mil poly is more susceptible to physical damage during installation, and breaks down after extended exposure to sunlight. Another product that is showing promise as an exterior membrane and is particularly well suited to wet climates is Tyvek® DrainWrap™, a vapor-permeable air barrier. Exterior membrane placement is key to maintaining a well-sealed, dry home (Figure 7). As codes for exterior membranes may vary by location it is important to check to see which type can be used in a specific region. It is typical in Interior Alaska to terminate the exterior membrane at the connection with top plate of the uppermost floor, as shown in Images 20. However, in wetter regions of Alaska, such as Southeast and other coastal areas, it is best to apply an additional course of exterior membrane to cover gable ends and any other wall sections that would otherwise be left exposed. This addition doesn't change the connection of the exterior membrane to the interior vapor retarder shown in Image 22.

Exterior Membrane.

Tyvek® DrainWrap™ differs from 6-mil poly and Grace Bituthene® because it is considered vapor permeable with a perm rating of 50. In locations where Tyvek® DrainWrap™ is code-acceptable, other components in the wall system are taken into account when calculating overall vapor permeability. For example, rigid foam boards range from less than one to five perms, depending on type and density. Half-inch plywood and seven-sixteenths-inch oriented strand board (OSB) are the exterior sheathings used in the vast majority of residential construction. Due in part to the exterior glues used in their manufacture, both products also have very low perm ratings, typically less than one. When rigid foam board, and the exterior sheathing are combined in REMOTE construction, the wall system as a whole provides a very effective barrier, and air movement from inside to outside is negligible. This point is important. Air movement is the primary vehicle by which moisture travels through walls. The combination of continuous overlapping layers of exterior insulation also does an excellent job of stopping thermal conduction to the framing members. By successfully addressing the air leakage and conduction issues, the physical conditions necessary for water vapor to travel through the building envelope are greatly reduced. In addition, as is typical for all REMOTE walls, should any wetting events occur in the framing, they will readily dry to the inside of the house.

Tyvek® DrainWrap™ as the exterior membrane is popular in Southeast Alaska and meets building codes in some Alaskan cities (Image 21). Where wind-driven rain and bulk water infiltration are a primary concern, Tyvek® Drain-Wrap™ is a good choice because facilitates draining and the structural components of the house are protected; a self-adhering waterproofing membrane will also protect well in this climate. Tyvek® DrainWrap™ is still undergoing testing by CCHRC researchers in Fairbanks as it is a region that experiences extended periods of severe cold in winter. The product has performed without issue in the three winters since the facility was completed. It is important to note that in all tests to-date adequate indoor humidity control was present through the use of HRV systems.

As mentioned in the framing overview, window and door jambs are flashed and sealed with a self-adhering waterproofing membrane to resist the weather at critical joints. Tyvek® FlexWrap™ in particular, does a good job of providing a continuous sill flashing that can be molded to wrap up the window sides. As an extra precaution, the wrap should be stapled around the edges to help it maintain its shape over the long term, rather than relying strictly on its inherent adhesive properties alone.

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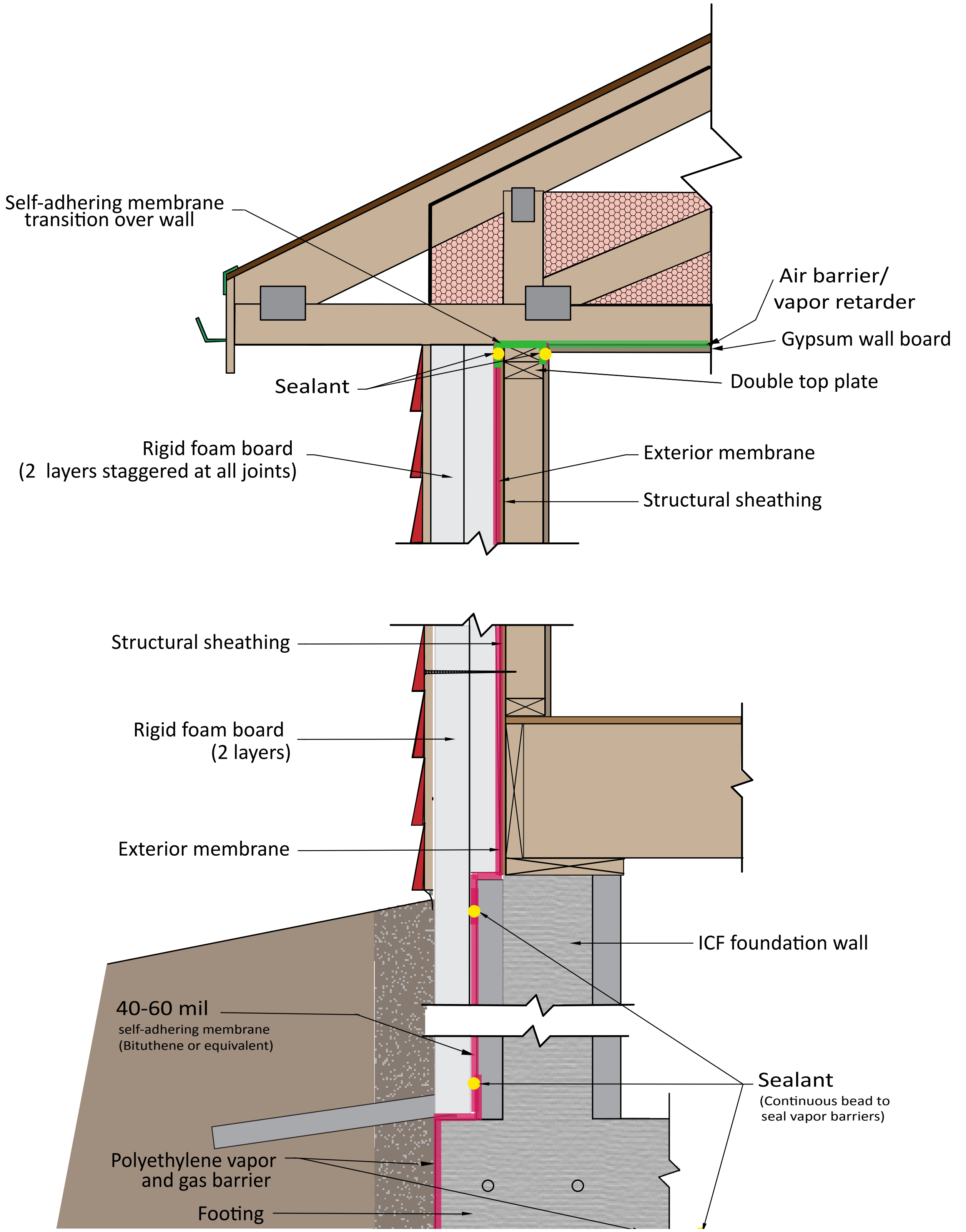


Figure 7. EXTERIOR MEMBRANE INSTALLED ON FOUNDATION, WALL AND CEILING

Exterior Membrane

Jack Hébert

Image 19. Grace Bituthene® exterior membrane, one of several vapor retarder options

Thorsten Chlupp

Image 20. 6-mil polyethelyne exterior vapor retarder, note installation of foam board against wall before installation of garage gable truss. For structures outside of Interior Alaska, the exposed wall sections under the gable ends should have the exterior membrane extended to provide complete coverage.

Image 21. An exterior air barrier is optional and subject to codes

Thorsten Chlupp

Image 22.   Adhesive strip detail

Jack Hébert

Image 23. Strip lapped over top plate and sealed to interior ceiling vapor retarder and exterior membrane

The Code.

The IRC (International Residential Code) requires a vapor retarder with a perm rating of less than one perm. Local codes may be more stringent, as is the case with the Fairbanks City Building Department which has amended the IRC to require a vapor retarder with a perm rating of .06, the equivalent of 6-mil poly. Ultimately, the choice of exterior membrane material rests in the hands of the entity that will be doing the inspections and code enforcement.

Some inspectors may consider the sheathing adequate if it has a perm rating of less than one, by taking the overall type of construction into account, while others may hold the building code to the letter and require a specific exterior membrane that has a compliant perm rating (Image 20). As a case in point, Juneau, Alaska is in a maritime climate with high ambient humidity levels and cool temperatures—a typical Juneau winter will experience multiple freeze-thaw cycles. It is an extreme climate in terms of condensation potential and weather-related issues as they affect residential construction. The Juneau building code approves properly constructed REMOTE homes that use Tyvek® DrainWrap™ over exterior-rated sheathings. The REMOTE wall system is proving itself to be an excellent performer in this challenging environment.

Vapor Retarder Details.

Continuity from the interior ceiling vapor retarder (typically 6-mil poly) to the exterior wall membrane is preferred whenever possible. While continuity may not be an option in REMOTE retrofits where the roof system is already in place, it is strongly recommended that this detail be addressed in new construction. The transistion from exterior membrane to interior membrane can be achieved by cutting strips of self-adhering waterproofing membrane that are wide enough to cover the double top plate and extend down both sides of the wall several inches (Images 22 and 23). On the exterior of the wall this strip laps over the exterior membrane, while on the interior, the ceiling vapor retarder extends down the wall and over the strip (Image 24). A bead of flexible sealant is used to seal the joint between the ceiling 6-mil poly and top plate strip. Any time sealant is used to join vapor retarders, this joint must have a solid backing to ensure a long-lasting seal. In this case, the edge of the double top plate provides the compressive support to ensure a positive seal. Since the upper surface of the double top plate is now covered, roof layout will have to be done with a permanent marker or other suitable means. On a building where all the double top plates are continuous, even if they change planes, a good membrane interface from interior to exterior can be achieved relatively easily with strips of adhesive membrane. Planning for easy membrane transitions from the exterior to the interior, over the walls, is easier in the design stages. One example involves scissor trusses and cathedral ceilings: rather than frame the gable wall full height, consider framing the wall so that the double top plate is in plane with the ceiling vapor retarder. Apply the membrane strip and set a gable truss or a dropped gable truss to complete the wall. Avoid piecing the vapor retarder together between stud bays and around studs. Unique issues with vapor retarder transitions tend to arise when building complicated structures.

Jack Hébert

Image 24. Transition of interior ceiling vapor retarder to membrane strip on double top plates

Exterior Membrane
Summary and Installation Tips

- Check with your local building inspector before building. Permeability rating requirements in a particular location are important to consider before choosing an exterior membrane.

- Several types of exterior membranes have been shown to work successfully with REMOTE walls. These include self-adhering waterproofing membranes such as Grace Bituthene®, vapor retarder such as 6-mil polyethelyne, or air barriers like Tyvek® DrainWrap™.

- It is essential in new house construction to form a continuous membrane that makes the transition from the interior ceiling to the exterior wall. This can be achieved by applying strips of adhesive membrane over the double top plate that lap several inches down either side of the wall. As the vapor retarder is now on the exterior sheathing, a vapor retarder is no longer needed on the interior wall, and should generally be avoided to prevent a “double vapor barrier” which can trap moisture in the wall.

Insulation

Overview

The use of rigid foam board in the REMOTE Wall System is to supply a high R-value in a practical thickness and to move the dew point from the stud bays to the exterior side of the sheathing. Both expanded polystyrene (EPS) and extruded polystyrene (XPS) lend themselves very well to the REMOTE system (Images 25 through 27). Polyisocyanurate (polyiso) is widely used for exterior insulation across the U.S., but hasn't typically been used in the REMOTE system in Alaska.

Exterior Insulation Choice

There are a few things to consider when selecting rigid foam board for use in a REMOTE wall:

- If the wall will be coated in stucco, then the stucco manufacturer will have specifications on sheet sizes, foam board types, and fastening methods.
- In wall systems that will receive furring there are more options. Either EPS, XPS, and polyiso can be used.

There are some differences in the products that are worth noting. Unfaced EPS has water vapor permeability ratings of between two and five perms per inch of thickness, and the foam board weight ranges from one to two pounds per cubic foot. Facings applied to EPS, such as the InsulFoam® R-tech® product line, can reduce the perm rating to less than one. The facer becomes the limiting factor in determining the insulation water vapor permeability. There is some question about how facings might affect moisture shedding in maritime climates and whether water can become trapped between smooth-facing surfaces. As a result, in a climate with consistently high ambient humidity levels and driving rain issues, an unfaced EPS may be a better choice (it is sometimes possible to peel the facers from the foam board if necessary). In Fairbanks, Alaska, the R-Tech®-faced foam boards have been used with good results. XPS foam board has a perm rating of a little over one perm per inch thickness. This rating is inherent to the foam board, as XPS is not typically manufactured with facers. In all cases, the individual layers of foam board should overlap at all seams and be staggered at the building corners to further limit any air flow through the wall. Gaps between the sheets should be filled with minimally-expanding spray foam.

Both EPS and XPS foam board have performed very well in tests of the wall system conducted in Southeast Alaska. Although some foams contain a borate additive to resist insect damage, this treatment may be subject to leaching over time in wet climates, particularly below grade. In situations where insect damage poses a significant threat, borate treatment as part of a comprehensive approach to pest management will provide the best preventative measures.

Polyiso foam board is typically manufactured with aluminum foil facers, which make this insulation highly water vapor impermeable (less than 0.1 perm). If unfaced, polyiso has a similar permeability to EPS. Polyiso is not intended for below grade applications. However, polyiso should be an acceptable choice in above-grade applications if properly protected from water. In fact it is an attractive choice from the perspective of achieving a target R-value while keeping the insulation thickness practical due to it's high R-value.

Further information on foam insulation properties is available in the Building America's Guide to Insulating Sheathing: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/guide_insulating_sheathing.pdf

Other exterior insulation types for REMOTE have been used or experimented with over the past several years, although experience in Alaska is still relatively limited. One new option is rigid mineral wool insulation, such as Roxul® COMFORTBOARD™. This product is similar to foam board in terms of installation, but is much more water vapor permeable or "vapor open," allowing for different moisture control designs than currently available with foam insulation. Other insulation options that have been pursued in Alaska include spray applied polyurethane foam and loose-fill insulation. These applications have good potential for use in the REMOTE system, but require different construction techniques for application and mechanical fastening of siding. These topics will be addressed in future revisions of the REMOTE manual.

Foam board Thickness.

Multiple layers totaling four inches, six inches, or greater are currently the most common foam board thicknesses used in REMOTE wall construction. To ensure that the envelope provides adequate moisture control, the amount of exterior insulation is guided by the local climate, as discussed later in the manual. Additionally, an energy model based on plans can be a useful tool to help gauge paybacks for a region's climate and energy costs.

Where Wall Meets Foundation.

How far the wall foam board extends over the foundation is discretionary and case dependent. The main issue is that the wall and rim joist faces be framed and sheathed so that the desired layer of foam board can make a smooth transition down over the foundation exterior. Avoid having a jog between the two faces where a non-standard thickness of foam board would be required to bring the walls into plane. If the foam board does not extend all the way down to the footing, but to just below grade, a non-frost susceptible backfill may be needed to prevent seasonal ground movement from lifting the overhanging edge.

Insulation Ratios by Climate.

Using the REMOTE wall system, a broad range of total wall R-values can be achieved, however, the balance of the interior stud cavity R-value to the exterior foam board R-value is an important moisture control consideration that will vary by climate. Achieving an appropriate balance of exterior and interior insulation is a very important factor in building a durable structure. If the balance is off, it can lead to moisture problems by allowing the framing to reach dangerously high humidity levels or allow condensation in the wall assembly. One of the most important variables in determining appropriate insulation ratios is climate. In general, the colder the climate region, the more the insulation balance needs to move to the exterior.

In conjunction with the exterior foam board, 30% to 50% of the total wall R-value can be added to interior stud cavities. While this is typically in the form of fiberglass batting, other common cavity fill insulation such as blown-in fiberglass or dense pack cellulose are good choices too. In Fairbanks, keeping this ratio around the one-third to two-thirds "rule of thumb" approach is a safe design that will prevent water vapor from condensing inside the wall framing. In contrast, Anchorage and Juneau can approach 40% to 50% of the total wall R-value in the stud cavity, whereas in Barrow the study cavity R-value should not exceed 30% of the total wall R-value.

FIGURE 8. INSULATION RATIOS BY CLIMATE

AHFC BEES Climate Zone	Representative city	Maximum % of wall R-value in interior (stud cavity)	Minimum % of wall R-value on exterior (over sheathing)
6	Juneau	57%	43%
7	Anchorage	40%	60%
8	Fairbanks	33%	67%
9	Barrow	28%	72%

Examples of construction practices that meet or exceed the above standards:

- In Juneau–4 inches of XPS or EPS on a 2x6 wall with maximum R-13 in stud bays
- In Anchorage–4 inches of XPS or EPS on a 2x4 wall with R-11 in stud bays
- In Fairbanks–6 inches of EPS on a 2x4 wall with R-11 or R-13 in stud bays

A REMOTE wall system with R-value distributions not in line with the percentages above will be less accepting of moisture. In these situations, once damaging moisture levels are attained in a wall cavity, tests indicate that the presence of stud cavity insulation will significantly slow the wall's drying time. Regions of Alaska north of Fairbanks can add a layer of conservatism by reducing the warm-side insulation to less than 30% of the total, or may even be best served by omitting warm-side insulation entirely. Equally important are educated occupants. Homeowners who understand how to operate the home and manage humidity will greatly affect how the wall system performs.

Case Study

REMOTE Wall Testing in Fairbanks.

CCHRC has been testing local climate limits by pushing beyond the one-third “rule of thumb” warm-side insulation ratio. The north wall of the office portion of the CCHRC Research and Testing Facility was built with six inches of EPS foam board and R-19 fiberglass batting in the stud bays, resulting in a total nominal wall R-value of approximately R-45. This exterior-to-interior insulation ratio is 58% to 42%, which places more insulation on the warm side than the guidelines in Figure 8. In three winters of testing, the wall section containing 42% warm-side insulation has only reached the dew point on one occasion. This spike in humidity was not sustained beyond the cold spell, and the elevated moisture levels disappeared once outside temperatures rose. Other walls in the facility have been insulated to R-13 in the stud bays and with six inches of EPS, which is in keeping with the guidelines in Figure 9. These walls have never come closer than 20 degrees to the dew point and have proven to be very safe performers.

Because CCHRC’s Research and Testing Facility has mechanical ventilation, the interior humidity levels in the winter are quite low, often well under 20% relative humidity. This helps reduce the risk of reaching the dew point within the wall framing. However, home ventilation in cold climates has been a long-standing challenge and many homes lack sufficient air exchange. Furthermore some homeowners choose to humidify because of the dry winter air. Therefore it’s not unusual for homes to have substantially higher interior relative humidity. To examine these conditions, CCHRC studied several REMOTE test wall constructions with different exterior and stud cavity insulation ratios. Lab conditions were maintained at 40% relative humidity for one winter, and 25% for the next. After two years, the test walls that didn’t keep within the guidelines in Figure 8 had abundant mold growth on the plywood sheathing and high wood framing moisture contents, whereas test walls that had insulation distributions consistent with Figure 9 had no visible mold and kept the framing moisture content well out of the risk zone.

There is some concern that if the fiberglass insulation does not completely fill the stud cavity, convective heat losses may reduce the effective R-value of the insulation in this area. One of the test walls at the CCHRC facility used R-13 fiberglass batting in the 2x6 stud bays, leaving approximately two inches of air space between the back of the drywall and the insulation. During the five coldest months of the 2008-2009 winter, the insulation value of the wall cavity (including the air space and the fiberglass) averaged a value of R-7, lending some weight to this concern. This drop in R-value was determined using calculations based on the known R-values of the insulation used in that wall section, in combination with the temperature recordings from the sensor string in the wall. Further study is warranted as no temperature sensors were located in either the fiberglass or the air space, and this wall was not set up to test for this phenomenon. Given all the variables involved, it is not possible to draw conclusions at this point.

Future testing.

As of early 2013, CCHRC is conducting testing to investigate differences in moisture control for the REMOTE system between water vapor permeable house wraps (e.g. Tyvek® DrainWrap™) and vapor impermeable membranes (such as Grace Vycor®) as the exterior membrane. See the discussion on page 21 for more background. Also included in this testing are different types of insulation, such as cellulose in the stud cavity and the exterior insulation. These tests are being conducted at ASHRAE design standards of 70 degrees F and 40% humidity for the interior conditions.

Image 25. Foam board is loosely attached to framing with a four inch sheetrock screw and a Wind-Lock® plastic washer

Image 26. Second layer of foam board is loosely attached using transferred stud pattern with eight inch screws and Wind-Lock® washers

Bays and Cantilevers.

The REMOTE system lends itself well to some areas that are difficult to insulate and seal properly using conventional methods. Any places where floors extend beyond walls and are exposed to the outside can be notoriously difficult to seal. The exterior foam and barrier membrane can be relatively easily cut to follow these types of projections, thereby effectively bringing them into the conditioned space of the building (Images 27 through 29). Keep in mind that any window layout in a bump-out is subject to change as the extra wall thickness produced by the foam generally moves openings further away from the corners.

Jack Hébert

Image 27. Close-up of a square cantilever bay window with attached foam board

Jack Hébert

Image 28. Foam board covering a curved cantilever

Jack Hébert

Image 29. Cantilevered addition wrapped with foam board

Insulation
Summary and Installation Tips

- A one-third interior to two-thirds exterior insulation ratio is considered safe in climates with 14,000 Heating Degree Days (such as Fairbanks) or less.

- The key to the REMOTE Wall System is moving the dew point in the wall to the cold side of the wall (exterior).

- Both expanded polystyrene (EPS) and extruded polystyrene (XPS) can be used in the REMOTE system.

- To make installation most efficient, be sure the first layer of foam-board insulation is applied straight and level.

- It may be helpful to transfer the stud locations on to the successive layers of foam board. The foam board only needs to be held in place well enough to stay aligned and resist winds until the furring is attached.

- To ensure continuous insulation, stagger seams between each layer so each seam is covered by solid foam board in the subsequent layer; transfer the stud location pattern to this layer. Continue this pattern for any additional layers.

- Stagger seams on corners.

- Fill gaps and damaged spots between the sheets with minimal expanding foam.

- Four inches of rigid foam board is the minimum recommended in cold climates; six inches yields higher performance in Interior Alaska.

- Wall and floor framing should be located on the foundation so that the exterior foam board can transition smoothly all the way down to the footer in one plane, without steps or jogs. Avoid having foundation wall offsets that will require non-standard thickness of foam board to make the transition.

- If foam board insulation does not extend to the footing, consider frost-resistant backfill to prevent the foam board edges from lifting.

- 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.

- Foil-faced foam board may not be suitable for climates where wind-driven rain can cause water to be trapped between the layers. Unfaced foam board provide better drainage and drying properties.

- Some foam board, such as Insulfoam® R-Tech®, can be special-ordered in three-inch thicknesses, which will speed up construction in walls using six inches of exterior foam. Note the limitations of your saw blades when ordering foam.

Bays and Cantilevers

Summary and Installation Tips

- In the REMOTE Wall System it is easy to apply exterior membranes and insulation to cantilevers.

- Extra insulation added to the floors of cantilevers is subject to the same one third warm-side R-value ratio as the walls.

Overview

In most situations, the wall furring provides the bulk of the structural attachment for both the foam board and the siding. The foam board layers can be loosely attached using a variety of methods: framing staples, nails, and washer-head fasteners can all work for the initial attachment. Keep in mind that the foam board should be attached well enough to resist winds until the furring can be applied. Lighter densities of foam board may require more care during furring installation because they may compress more readily if the fasteners are overdriven, especially around openings.

In the field 1x4 dimensional lumber and wider three-quarter-inch plywood corners are typically used for furring. The plywood should extend far enough in both directions to allow positive attachment into the corner framing as well as be able to provide surface area for the desired width of corner trim and siding terminations (Images 30 through 36). In wet climates, venting the spaces between the furring strips at the top and bottom, and around windows and doors, is an option. Good air flow behind the siding will help with drying by providing an exit path for any moisture that makes its way past the siding. Image 36 shows a furring pattern appropriate for wet climates.

Structural Screws.

The standard fastener for attaching furring is a pan-head panel-type roofing screw that is long enough to pass through all layers of foam board and penetrate securely into the framing. As a rule, all furring that supports siding should be fastened to the wall framing members (Figure 9). Most screws of this type will have a reasonable corrosion resistance, but if they will be used below grade, in treated wood, or in an extreme environment, it may be necessary to consult the manufacturer. An impact driver often makes for much easier installation. Screw head profiles range from #3 Phillips, Torx, Star, and Square drive among others, to make for more positive driving. Screws should penetrate through the sheathing and a minimum of 1.25 inches into the studs. Longer screws are available, including half sizes in some brands, if significant upsizing is desired.

With 2x4 walls in particular, keep in mind that errant fastener penetrations can run the risk of damaging wiring or plumbing runs in the exterior walls. Vertical fastener spacing can vary from one to two feet on center, depending on the siding and wind loads. Driving the screws in at a slight upward angle, such as 0.5 inch in six inches is highly recommended as it creates a mechanical advantage that significantly increases the bearing capacity of the assembly (Figure 9). In addition, a truss clip can be attached to any rafter tails that line up with the furring. In any situations where excessive structural, seismic, or wind loads are an issue, it is recommended that an engineer be consulted to verify that the construction methods are appropriate to the conditions. Metal fasteners are very conductive and any long screws that penetrate from the exterior to the interior can present a condensation point. In these cases, a scrap of foam board big enough to cover the exposed portion of the screw can be pushed on the screw tip and sealed to the sheathing with spray foam.

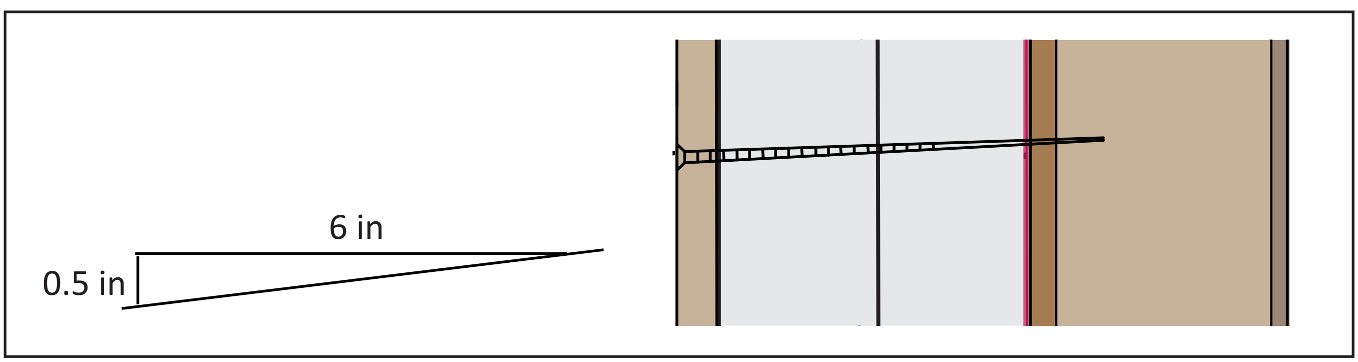
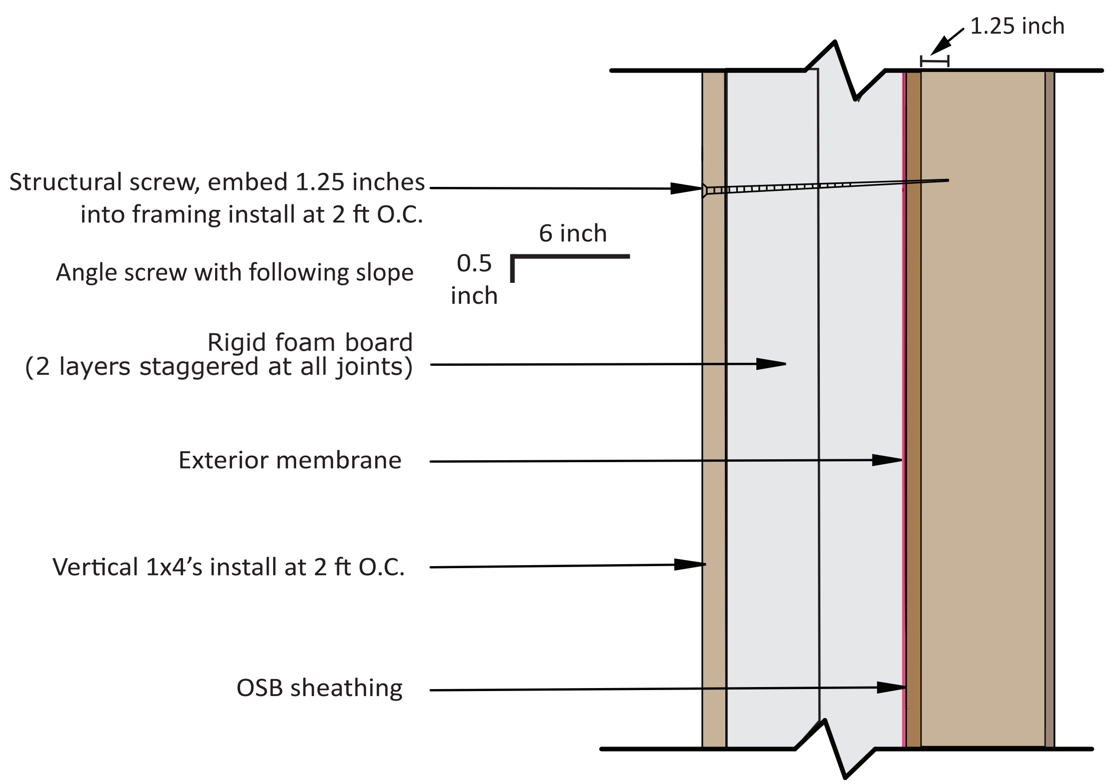
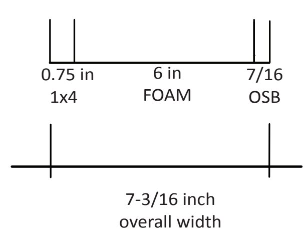


Figure 9. SCREW PLACEMENT AND ANGLE

ATTACHMENT INFORMATION	
Vertical Load capacity of loaded screw from ESR4078	.187 inch
Oly Log/Timber Lok screw load capacity (136 lb/6 inch)(0.5 inch)= Shear= 11.3 lb	136 lb/inch
Hardie Plank 11.3 lb/(2 ft x 2.3 psf) = 2.5ft = 29 inch	Install screws 24 in O.C.*
Wood and vinyl siding Install screws per manufacturers specifications	Typically 24 in O.C.



SIDING WEIGHTS	
Hardie Plank	2.3 psf
Wood: 7/16 inch OSB	1.3 psf
Vinyl	0.5 psf



* O.C. - on center

Figure 10. FURRING AND SIDING DIMENSIONS, WEIGHTS AND ATTACHMENT DETAIL

Thorsten Chlupp

Image 30. Pre-drilled furring speeds installation process and keeps fasteners at a consistent height to avoid conflict with interior mechanical runs through the stud bays

Image 31. Exposed fasteners inside the wall must be covered to prevent condensation

Furring and Siding

Thorsten Chlupp

Image 32. Vinyl siding in progress, note furring around chimney support

Thorsten Chlupp

Image 33. Furring wraps around the window buck edges so the window can seal directly to the membrane on the buck. In wet climates, spaces above and below windows, and above doors, should be vented.

Image 34. Detail of wider furring on corner, allows for fastening to corner framing

Marquam George

Image 35. Vinyl siding in progress. Note that all spaces between furring strips are vented rather than capped.

Jack Hébert

Image 36. REMOTE home with multiple exterior finishes

Furring and Siding

Summary and Installation Tips

- 1x4s are a good choice for furring strips; treated wood may be a better choice in wet climates.
- Be sure the corner furring is wide enough to allow fastening to the corner framing and to attach siding.
- Check with your local dealer in advance about the fasteners you will require to make sure they have them in stock.
- Screws to hold furring strips should be driven 1.25 inches into the studs, not counting the sheathing.
- Screws should be driven at a slight upward angle (0.5 inch vertical rise for every 6 inches horzontal, from front to back) to increase their bearing capacity.
- The vertical fastener layout for attaching furring strips is usually 24 inches on-center but consider the siding that will be used before attaching the furring.
- Any metal fasteners that can conduct cold and are exposed on the inside of the wall should be covered with some type of foam insulation to prevent condensation.
- If furring will be attached before mechanical systems are run in the exterior walls, consistent heights in the layout pattern for screws will minimize any interference or damage, particularly in 2x4 walls.
- Be sure to let the plumbing and electrical subs know at what height increments the furring fasteners are located so they can drill their holes through the studs without damaging their tools or the screws themselves.

Ventilation.

Due to the nature of their construction, homes built using the REMOTE Wall System are very tight and will require an external source of fresh air. Exhaust-only systems with passive fresh air intake vents and HRVs are both viable options.

Retrofits.

As an energy retrofit measure, the REMOTE system lends itself especially well to relatively straightforward home construction with wall planes that have minimal obstructions such as bump-out bays, multi-story decks, and other attached exterior structures. Sometimes the complexities involved in achieving good exterior barrier continuity, flashing details, and proper insulation thicknesses are simply not viable for REMOTE, or are prohibitively expensive. Homes being considered for a REMOTE retrofit need to be decided on a case-by-case basis. Fortunately many older homes and subdivisions used simpler construction methods and make good candidates, particularly those with T1-11 siding.

Another point to consider is that most Alaska retrofits will have existing interior vapor retarders, which creates a "double vapor barrier" situation that is unavoidable for practical reasons. That means vapor that migrates through holes in the vapor retarder can be trapped in the wall, as exterior foam blocks the drying path to the outside. The positive side to this situation is that if the proper inside-to-exterior insulation ratio is maintained, and the exterior membrane and flashings are detailed correctly, CCHRC research has shown that this "double vapor barrier" effect should not be a problem. While the presence of an interior vapor retarder will significantly slow drying to the inside, having the proper amount of outside insulation has been shown to be a more significant moisture control element in Interior Alaska. These findings should translate to other climate regions of Alaska, assuming that potential exterior wetting mechanisms have been addressed in the retrofit. In all circumstances, a mechanical air exchange system is necessary for an older home that has undergone a retrofit. Mechanical ventilation will help ensure adequate moisture control and a source of fresh air, both of which are critical to occupant health and building longevity.

New construction.

There are many possibilities for new construction. What matters most is that the concepts and principles presented here are taken into account during the planning stages. This will help to make informed decisions that will contribute to overall labor savings and energy performance. As an example, exterior transitions such as cantilevers and large bay windows can be time-consuming to seal and insulate properly. The REMOTE system simplifies the detailing in these areas by attending to them on the exterior where they can be readily incorporated into the continuous thermal envelope provided by the rigid foam board.

One of the biggest hurdles to widespread use of the REMOTE Wall System is a lack of trained crews and contractors familiar with the construction processes. This is changing. For example, the U.S. Army is adopting the REMOTE system for hundreds of new homes designed to meet military housing needs in Interior Alaska. The system is being embraced more readily as perceptions in the home construction industry are changing. Energy efficiency and a longer-term view of home ownership are driving forces that help make REMOTE construction a viable—and attractive—option.

Conclusion

To ensure that you have the tightest building envelope possible, consider conducting a blower door test. The best time to do this is when the foam board, exterior membrane, ceiling vapor barrier, windows and doors are all in place and the ceiling has been sheetrocked. Ideally any plumbing and wiring penetrations will also be in place. At this point, the blower door test provides a good diagnostic tool for determining the specific locations of air leaks when they can be easily identified and remedied.

Ultimately, the overall performance of the REMOTE Wall System is dependent on two main factors in the construction phase: the materials used and the attention to detail given during assembly. To date, all walls that have been tested by CCHRC have used an exterior sheathing—either 0.5 inch C-D Exposure 1 plywood or seven-sixteenths OSB. This line of reasoning stems from the fact that the vast majority of residential structures use these products to meet building codes. To date, no testing has been done on walls without exterior sheathing in combination with an air retarder in place of a vapor retarder. Doing so would place the exterior foam board in the role of the sheathing by exposing it directly to the warm-side environment. It is an entirely different product and its performance under these conditions is unknown.

CCHRC staff continues to research various aspects of the REMOTE Wall System and hopes to make the shift to a new construction process as easy as possible for builders. In addition to this manual, other materials about this process are available, including a DVD, cross-sectional drawings, and pictures of some of the more unusual situations that may arise due to the diverse nature of home construction. We welcome your comments on this process and other construction challenges unique to the cold climate environment.

Jack Hébert

Image 37. Completed 6,800-square-foot custom home using six-inch REMOTE walls

How to Build the Typical REMOTE Wall

1. Frame and sheathe exterior walls.
2. Apply exterior membrane, i.e., self-adhering waterproofing membrane, 6-mil poly, or Tyvek® DrainWrap™
3. Exterior-mounted or inset windows
   a. Exterior-mounted Windows
      i. install full-depth window bucks and flash to meet climate conditions
      ii. Install windows over flashed buck framing and flash nail flanges
   b. Inset Windows
      i. install windows and flash to meet climate conditions
      ii. Build and install exterior jamb extensions over windows
4. Doors – Build and install door sills and flash openings as required
5. Install deck blocking or other exterior blocking as required (i.e., hose bibs, electrical, vents, etc.)
6. Install overlapping layers of foam board until desired insulation thickness is reached, using the warm-side ratio calculation
7. Install vertical furring over studs and corners to support siding.

Note: Screws used for furring attachment must penetrate framing to support structural loads and avoid condensation points in wall. Furring can be pre-drilled on layout before installing to speed process

8. Install exterior window furring to support finished window trim
9. Install desired siding and exterior trim
10. Inspect and seal any interior fastener penetrations, paying special attention to any metal connectors that can conduct cold to the inside and pose condensation problems.

Cold Climate Housing Research Center

CCHRC

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