

5b. Wall insulation – Seal it, pack it and wrap it

Survey results of walls

The survey found that all cavities in exterior walls were insulated; however, the types of insulation ranged from glass fiber to cellulose to a special foam. The performance of any product is mostly a function of careful installation. Even though insulation is not typically credited with reducing air leakage, half of the homes insulated with glass fiber products had air-change rates higher than the highest air-change rate found in the homes insulated with cellulose.

Steps to a better-performing wall

Since the wall is typically the largest element in a home, attention to the details of construction will help to make the walls energy-efficient, water-resistant, and long-lasting.

1. Use framing techniques that reduce the amount of wood in the wall. Wood is a poor insulator and it displaces the insulation in the wall.
2. Air seal before insulating. Insulation, unless it is an expensive foam product, does not air seal. It is important to seal all holes made through the exterior sheathing, the top plate, and any other hole that allows outside or attic air to enter the wall's cavity.
3. Install the insulation carefully. To be effective, insulation must be installed so that the movement of air will not reduce its effectiveness.
4. Use a good housewrap product (one without visible holes) and install it in such a way that it sheds water, prevents wind from blowing in and allows water vapor to exit.

Wall insulation



Framing the wall



Exposed foam will be covered with drywall and molding



A leaking bottom plate



Sealing bottom plate with foam sill-sealing product



Wiring penetration in top plate is open to attic.



Penetration is sealed with foam caulk.

Installing insulation carefully

Step 1: Air seal all wall penetrations. Step 2: Insulate by completely filling all voids – edge to edge and top to bottom.

Faced insulation has a vapor barrier "face" attached to the insulation. Tabs on either side of the facing are used to staple the insulation in place. To allow the insulation to expand to its proper thickness, these tabs should be stapled to the outer "face" and not on the inner sides (inset) of the studs. Even though the manufacturers say that if properly installed, both face and inset stapling methods are "acceptable," research has shown and many professionals recommend face stapling because it allows a full expansion of the insulation and reduces the air currents that carry away the heat. Some drywall contractors have not had experience with this technique, but if faced batts are to be used, this is the best way to install them.

Stapling the tabs on the inside of the studs reduces the effectiveness of the insulation for two reasons: 1) it compresses the insulation, which reduces its R-Value; and 2) it allows air to easily move, thus actively transferring the heat.

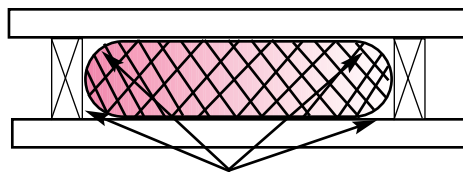


The combined effect of compressed insulation and air circulation can reduce the effective insulating value of an R-13 batt to a value below R-10.

Because some drywall contractors have difficulties with face stapling, there are two alternatives that can be used:

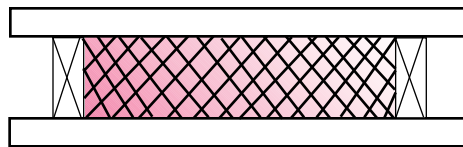
1. Inset staple not only the sides but also the top and bottom. Cut the insulation 2 inches longer than the stud space, then fold back 1 inch at the top and bottom, and staple as flanges. The air in the pocket that is created with this inset is now trapped, and the insulation value of the dead air pocket almost offsets the compression of the insulation.
2. Use unfaced insulation. These wider batts rely on friction-fit for support. Since they are not stapled, they can often be installed in less time. Also, it is easier to cut unfaced batts to fit around wiring, plumbing and other obstructions in the walls

Neither unfaced insulation batts nor loose-fill products provide a vapor retarder. Use a vapor retarder drywall primer and sealer with a perm rating lower than one to reduce moisture diffusion through the interior finish materials.



Air Pockets

Inset stapling can create many air pockets



Unfaced batts can more easily fill the cavity

Wrapping insulation around boxes and wiring

Install fibrous insulation around pipes and electrical outlets and panels. Fill all of the space with insulation. Rip the insulation apart to allow some to go behind and some in front of the obstacles. Cut out the insulation around plumbing and electrical outlets, and stuff the insulation behind if any space is available.

Drying before closure

It is important that the framing of a building has dried out as much as possible before the insulation and finishing are done. A propane heater releases excess moisture that interferes with the drying process. Suggestion: hook up a temporary heating system that will really dry out the house. Do not use the home's new heating system because this will introduce dust and construction debris into the ducts and permanently damage the heat exchanger or coils.

If wet-blown cellulose has been installed in the walls, it needs to dry to manufacturer's specifications prior to closure. Typical drying times are 24 to 48 hours depending on the weather. If the temperature is 40°F or below, it may be necessary to use supplemental heat until the moisture content is 25 percent or less. (Source: Cellulose Insulation Manufacturers Association) Cellulose dries to about the same water content as kiln-dried wood – 10 to 15 percent moisture. If it feels dry to the touch, it is ready for the dry-wall. Any remaining moisture will dry to the outside.

Wall insulation



Compressed insulation not only loses its R-Value, but it also creates an open void where circulating air can further reduce the thermal effectiveness of the wall.



Pull the insulation apart and place some behind switch boxes and cut openings for outlet boxes. Note the use of unfaced batts. Note also protective mask, goggles, gloves and long sleeves help to protect worker during installation.

Housewrap installation

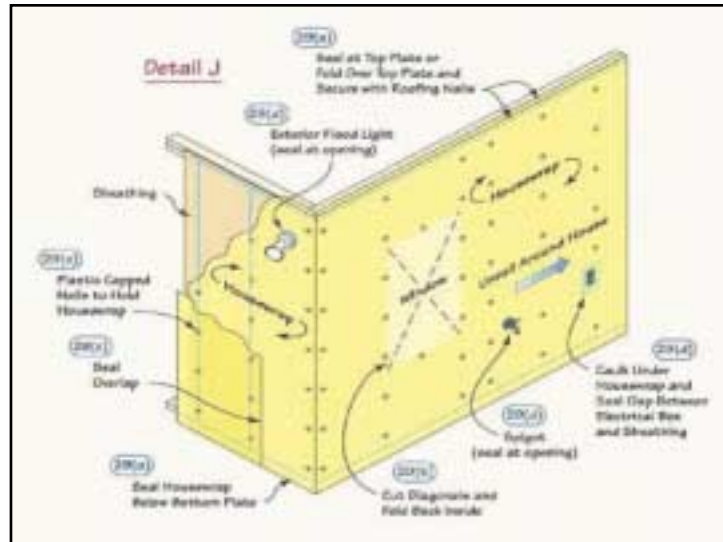
Wall insulation

The survey found that almost all homes had a housewrap product on the exterior walls; however, the installation was poorly done in every case. There are three reasons for using a good exterior housewrap: 1) to direct the flow of any surface water on the housewrap to the outside; 2) to reduce incoming air from leaking into the house; and 3) to allow interior water vapor to pass through the walls.

Not all housewraps are the same. The best is made with microscopic pores that are large enough for water vapor to pass through, yet small enough to resist air and liquid water penetration. Products that look like housewrap but attempt to do these same functions with many small pinholes do not do a good job of reducing air leakage, and liquid water is also allowed to pass through. Hold a piece of housewrap up to the light; if many small pinholes are visible, the material will not do a good job protecting the wall.

Improper housewrap installation allows the entry of water into the wall. Many vinyl-sided homes have experienced water leakage, and improperly installed housewrap is usually the culprit. (Source: Spiderman's & ITA Systems, a Florida company that conducts building water leakage investigations) Install housewrap over exterior sheathing and under foam board. Think of housewrap as flashing or shingles – start at the lowest level and overlap the layers above it. Tape all holes, tears and punctures. Use large head or, for optimum protection, plastic washer-head nails. If staples are used, make sure that they are wide with a 1-inch minimum crown to prevent the housewrap from tearing away from a smaller staple head.

The detail shown at top right (source: U. S. Department of Energy) shows information about the many areas where housewrap needs to be overlapped, caulked and sealed.



Note that this has the commonly used "X" cut for window installation. Cutting an "X" in the wrap and placing the window over the wrap (below) can direct water into the back side of the window assembly and into the wall. It is important to put the window flange and head flashing under the housewrap. This directs any water coming down the face of the wrap over the window instead of under the flashing and into the wall.

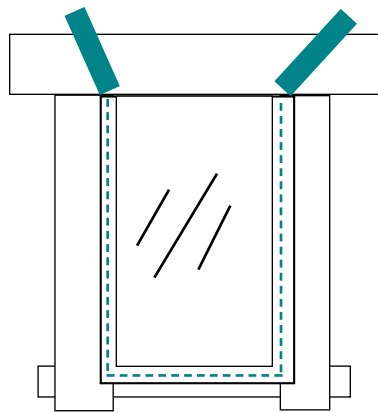
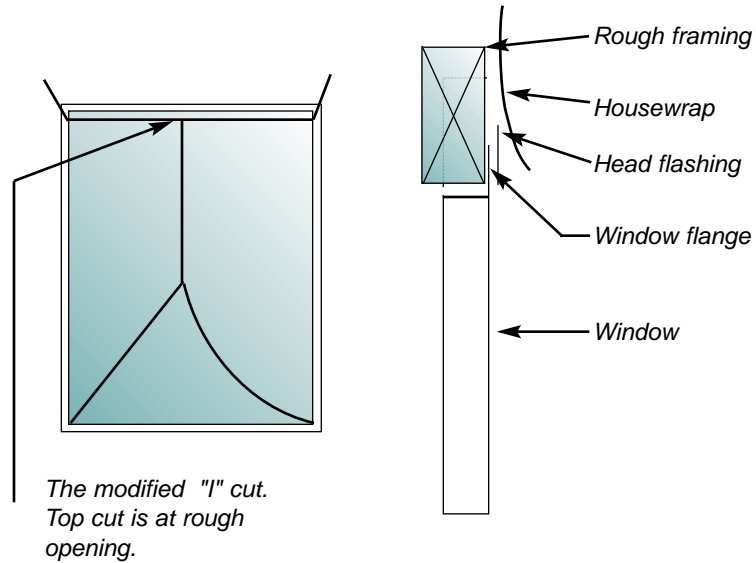


Wall insulation

DuPont has a comprehensive Weatherization System. These are their latest installation instructions:

1. Unroll housewrap starting at corner leaving a 6-inch to 12-inch overlap. Line up printed stud marks with first stud.
2. Start at bottom and check for plumb. Edge of bottom roll should extend over sill plate at least 2 to 3 inches. For best air leakage reduction, seal wrap with caulk or tape.
3. Secure housewrap every 12 to 18 inches on vertical stud line with large head or plastic washer head nails. Wide staples with 1-inch minimum crown can also be used. When attaching wrap to masonry, use adhesives with polyurethane, elastomeric or latex base.
4. Unroll directly over windows and doors. Overlap upper rolls 6 inches over bottom rolls. Attach housewrap up to and covering the top plate.
5. Create a continuous membrane by overlapping and taping all seams, as well as band joists and headers. Tape overlaps with 2- or 3-inch DuPont contractor tape or equivalent. Tape accidental tears or damage.
6. Make a modified "I" cut (right) in housewrap.
7. Fold flaps inside around openings of windows and doors. Fasten every 6 inches and trim excess.
8. Tack up bottom sill flashing overlapping rough sill by 4 to 5 inches. Best practice: make two vertical corner cuts in the flashing and fold flashing inside over rough sill.
9. Tack up side flashings overlapping bottom sill flashing. Install window or door, according to manufacturer's instructions, over side and bottom flashing. Make sure that the top window flange is attached under the house wrap.
10. Cut two 45-degree angles upward from each top window corner. Install head flashing UNDER top flap of house wrap and OVER window flange. Head flashing should extend out over side flashings by 3 to 4 inches. Fold top flap of housewrap OVER head flashing. Tape both diagonal cuts.

Wall insulation



This detail shows the two taped-over 45-degree cuts in the housewrap, as well as the top flashing that is extended over the side flashings. The top flap of the housewrap is lifted for the window flange and flashing and then folded over and taped on top of them

Drywall as part of the air sealing package

Air sealing is not a vapor barrier – they are two different issues. The best and most economical approach to building a tight home is to use the drywall as a part of the air-sealing package. The prevailing wisdom is to "build it tight and ventilate right." Junctions or connections in a wall are the most critical locations for air leakage:

- Where the wall meets the windows and doors
- Where the wall meets the roof
- Where the wall meets the floor or foundation
- Where the wall or ceiling meets the supply and return vents
- Where there are penetrations for dryer vents, refrigerator water, plumbing, electrical and gas lines.

Polyethylene vapor retarders

Polyethylene vapor retarders can be a serious problem in Arkansas' humid climate as homes become tighter and ventilation is inadequate. In northern, cold climates, the "warm side of the wall" is always on the inside, and a vapor barrier on the inside of the wall helps to reduce the flow of moisture laden air which can condense as it reaches the cold exterior. In Arkansas, both sides of the wall are the "warm side" depending on which season it is. During the summer it is important that the moist outside air does not have a chance to condense on the cool surfaces inside a wall. By maintaining a slight, positive air pressure inside the house (see page 67), any leakage will be directed to the outside.

Wall insulation



Gaps in the drywall can be air leakage sites.



The attic access door should be treated as an exterior door with good weather-stripping, a threshold and a secure latch. Best practice would also include adding some rigid insulation to the backside of the door

Knee walls are really "vertical ceilings"

An exterior wall insulates the inside from the outside temperatures. A "knee wall" functions as a vertical ceiling because it insulates the inside from the attic temperatures that are frequently much hotter than the outdoor air temperatures in the summer. Because a knee wall is framed with 2x4's it does not mean that it can hold only R-13 insulation. Many new homes have experienced difficulties conditioning upstairs areas because the knee wall was insulated with R-13 insulation and these batts were left exposed to the attic temperatures.

The best approach to fixing this problem is to cover the exposed batts with foil-faced insulated sheathing. This will not only add at least an R-3 but will also help the insulation work better by trapping the air within the cavity and reflecting the attic's radiant heat.



Many homes have more complicated ceilings with several vertical elements. These should also be treated as vertical ceilings with the insulation enclosed using some solid material.

Wall insulation



Batts of wall insulation that are left exposed to attic temperatures have little insulating value because they allow air to circulate



Ceiling insulation should be placed directly against vertical ceiling elements, otherwise, convection will transfer attic temperatures to ceiling.



Trap the air in the insulation by sealing the knee walls with reflective foam insulation. Note that seams are taped for better sealing.