SEALED ATTICS?

Bringing attics inside the conditioned space can help save homeowners as much as 18% to 20% on their energy bills.

BY BRIAN COBLE

Most attics are designed and built to be outside the home's thermal envelope. Insulation gets blown, placed, or stuffed between the ceiling joists at the base of the attic, but the space above those joists is left unconditioned and intentionally vented to the outside. The only time most people bring the attic inside the envelope is when they want to convert it to a living space.

I would like to make the case for a different approach. I believe that, in some homes, it's better to bring the attic inside the envelope by insulating and air sealing the roof deck and gable walls—even if the attic will never be used as living space. This approach can really earn its keep in homes where HVAC equipment and ducts are placed in an unconditioned attic, and where the attic ducts are leaky. In those cases, the energy savings may go a long way toward helping to pay for the change. An insulated attic also offers the added benefit of more storage space for the homeowner.

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In this article I will outline when and how to bring the attic into the thermal envelope, including what materials to use, how to handle key details, and how to avoid common pitfalls. I find that it's best to make the attic a "tempered" space rather than a conditioned one—that is, by insulating and air sealing the roof deck and the gables, but not putting a dedicated heating or cooling register in the space. The main reason is cost: The attic won't be used as living space, so it doesn't make a lot of sense to put a dedicated supply and return there. Air leakage from the living space should be enough to keep the attic at a moderate temperature.

Much of my emphasis is on air sealing, because if you insulate the roof deck but don't air seal you will have wasted your time. That's why I recommend using spray foam insulation, which will insulate and air seal at the same time.

None of this is rocket science, but as you will see, getting the most out of this approach requires attention to detail. Therefore, I also make the case for better installer training.

WHEN THIS APPROACH MAKES SENSE

Why should you at least consider insulating and air sealing unfinished attic spaces? The main reason is that doing so can lower the homeowner's energy bills. If ductwork runs through an unconditioned attic, properly insulating and air sealing the attic can lower heating and cooling consumption by as much as 18%–20%. This can be true even with insulated and sealed ducts. With typical R-values as low as R-4 (less than ⅓ the R-value of a typical exterior wall), a heating supply duct in a cold attic (or a cooling duct in a hot attic) is going to lose energy to its surroundings.

To determine whether this approach is right for a particular home, you need to weigh the costs against the potential benefits. The cost to insulate an average 1,700–2,000 ft^2 roof deck with spray foam can range from $2,000 to $4,000, which can be a hard sell for homeowners on a tight budget. For instance, I have had discussions with Habitat for Humanity about insulating and sealing their roofs, but we concluded that, given the cost of the homes, it would make more sense for them to send volunteers in the attic with several tubes of caulk and simply seal the holes around the ceiling plane.

Foam is an especially good choice for homes with complex structures, where traditional air sealing would eat up lots of labor time. In fact, the more complex the structure, the better foam looks. The actual installed cost will depend on local insulation costs, the total roof area, the amount of blocking and prepping needed, and the condition of the roof shingles. More on these issues below.

HOW DIFFICULT IS IT?

As I noted above, most attics are built to be drafty, and that includes more than the obvious ridge, soffit, and gable vents. Framing, siding, and trim was likely put on without any thought to keeping drafts out of the attic, because it makes little sense to do so in a space that will be open to the outside anyway. That means there will tend to be more cracks, gaps, and holes than you expect. If the roof is anything more complex than a simple gable, finding and sealing these gaps can pose a real challenge.

A major reason to use spray foam insulation is that if you use fiberglass or cellulose, you have to spend a lot of time on air sealing before calling the insulator. Spray foam simplifies the job by doing both, which can be more cost-effective. (Even if it would cost less to air seal with a two-part polyurethane and insulate with batts, I would still recommend using spray foam, as I find that it usually does a better job.)

It's very important to choose the right type of foam for the job. Spray foam comes in open- and closed-cell formulations. Open-cell foams are vapor permeable, while closed-cell foams can actually qualify as a vapor retarder. Which one to use will depend mostly on climate.

In the North

When you insulate a roof deck in a northern climate, warm, moist air from inside the house can work its way through the insulation and then condense on the cold surface at the bottom of the sheathing, where it can cause problems. In these climates I would suggest a two-part closed-cell foam to block moisture flow. Because the attic side of the foam will be close in temperature to that of the house, condensation won't be likely.

In the Southeast

When finishing an attic in a hot-humid climate, I recommend using an open-cell foam, which allows moisture flow. This will let some humidity move from outside to inside the house, but the mechanical system should dry it before it has a chance to condense on any cold surfaces.

In the Southwest

Moisture isn't a big issue in hot-dry climates, so you can use either type of foam.

PREPPING THE ATTIC

Assuming that the roof is in good shape, there's still a lot of prep to be done before spraying the insulation.

In areas that get a lot of rain you should make sure that the roof is in good shape before foaming starts. If you spray foam into a marginal roof system and the roof starts to leak soon afterward, you will be blamed for the leak—even though the insulation had nothing to do with it. If the roof shingles look like they're close to failure, you should suggest that they be replaced. If the homeowners refuse, the wisest course of action is to walk away from the job. Many contractors are reluctant to do this in a tough market, but it's better than being held liable for a problem you didn't cause.

If the roof is sound, most of the prep work will involve plugging large holes. (You don't want to see foam oozing out through the roof.) Some of this can be done from outside the house, while some of it involves crawling around inside the attic.

You will obviously need to plug all intentional vent openings. These include disabling (removing and/or capping) gable and ridge vents, and removing roof-mounted exhaust fans. Large holes, such as those left by an exhaust fan or gable vent, will need to be plugged with framing and sheathing and then covered with siding or roofing.

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Here's an example (*from top down*) of closed cell foam being applied in an exterior wall as a skim coat for air tightness

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Attic roof deck with open cell foam applied. Notice all mechanicals are now located in the conditioned space.

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Blocking has been applied between rafters to ensure foam does not fill the soffits.

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A technician applies closed cell foam to an unvented attic assembly.

You will also need to do some sealing and blocking inside the attic. This may include plugging large gaps with a solid backing to spray the foam against. One example is the space between the top wall plate and the roof deck on a home with a vented soffit. These and other such penetrations can be sealed with a number of different backing materials, ranging from oriented strand board to fiberglass insulation to solid lumber; the foam is then sprayed over the backing.

Old kraft-faced (vapor retarder) batts will have to be removed. This helps to ensure the attic and living space below will easily transfer moisture from one zone to the other. The better coupled the two spaces, the less likely it is that moisture will become a problem.

If it's a one-story home with an attic that covers the house and the garage, you will have to build an insulated partition to separate the attic into a conditioned space over the house and an unconditioned space over the garage. Depending on the house and the budget, this can be expensive enough to be a deal killer, so you need to carefully think through the time and expense needed to make that partition.

Code requirements also come into play during the prep stage. For instance, you can't spray foam into the gap around a chimney or combustion exhaust flue; these need to be sealed with code-approved materials like rock wool and fire-rated caulk. New insulation may also need to be covered with a fire-rated material, but only if it's on a vertical surface. In other words, you don't have to cover the underside of the rafters, but you do need to cover the knee walls. It doesn't necessarily make sense, but that's the way it is.

SEALING THE DUCTS

As I mentioned above, one great benefit of tempering the attic is that it brings the attic ducts into the thermal envelope. While this is a good idea even if the ducts are well sealed, the fact is that most ducts are leaky. As of five years ago (the most recent numbers we have), the average duct leakage for new homes in North Carolina, where I live, is 15%; the average duct leakage for existing homes is probably closer to 25%. Insulating and air sealing the attic keeps that leaked air inside the house.

Although sealing the attic will capture duct losses, it won't eliminate all problems caused by leaky ducts. That's why I still recommend duct sealing.

In a healthy duct system, the supply and return ducts are balanced in a way that equalizes atmospheric pressures throughout the house. A leaky duct in the attic could throw the system out of balance, putting some of the rooms downstairs under negative pressure. This can cause a number of problems, which include pulling moisture and unconditioned air in from outside. However, the worst potential problem is that if the home has atmospherically vented combustion appliances, this negative pressure could pull CO and other combustion by-products into the living space.

Unfortunately it can be tough to find an HVAC company that seals its ductwork properly, and in my experience most don't have a real piece of diagnostic equipment, such as a Duct Blaster. However, you can at least make sure that all duct sections are connected and that there are no obvious cracks.

GETTING THE INSULATION RIGHT

If you have done a good job of blocking, caulking, and duct sealing, you still need to make sure that the foam is properly installed. While there are many top-notch foam contractors, I have also seen many problems in the field. For instance, if the foam's moisture isn't correct during installation, air bubbles can form in the foam as it cures, reducing R-values; if it's put on at the wrong temperature, it can pull away from the framing. I have also seen large variations in thickness, and insulators who don't fill the framing cavity or who miss critical areas.

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One problem is that while air sealing is one of the main selling points for foam insulation companies, the industry's growth has led companies to hire installers who may or may not understand how to install foam to create a good air barrier. This has created a real need for installer training.

Advanced Energy is addressing this need with installer training for foam contractors. It includes on-site training, as well as a set of illustrated laminated reference sheets that are kept in the truck to remind the installer what to do in various situations, including details on how to do the type of attic finishing job described here. This training benefits the installing crew, as well as the home performance contractor who has to check the insulator's work. The payoffs will include happier homeowners and more energy-efficient homes.

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