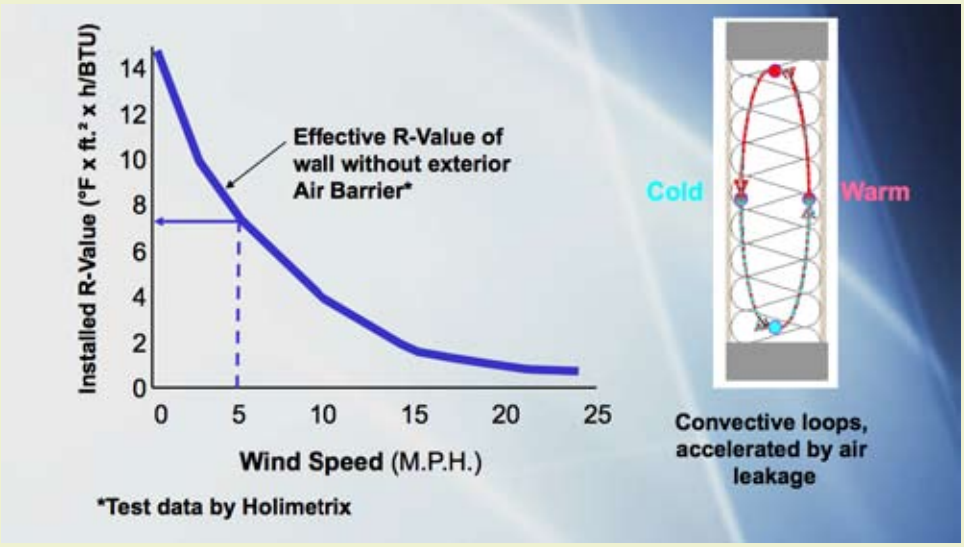


This chart shows the drop in effective R-value as air infiltration increases due to wind.

Hybrid Insulation Systems

Is a flash and batt insulation system right for your homes.

Text and photos by Steve Easley

In the never ending quest to get the best building envelope for the dollar, builders have discovered that an insulation system sometimes referred to as flash and batt or hybrid insulation systems can be a cost-effective way to get a higher-performing building enclosure.

Hybrid systems can perform quite well. The system is a combination of fiberglass batts or blown fiberglass and closed cell spray foam in the wall cavity. Some builders are also using spray foam and blown insulation in attics.

The beauty of the hybrid system is that it marries the high-performance capabilities of spray foam with the economics of fiberglass, which creates a less costly, higher performing wall.

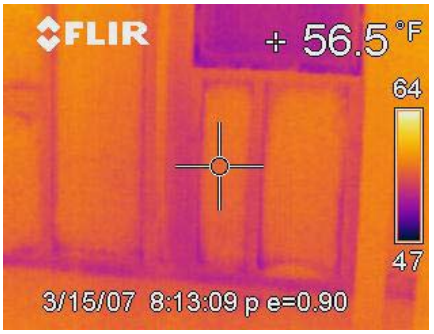
The wall system can be 2x4 or 2x6. The process involves first spraying a layer of closed cell spray foam, usually ½" to 1" thick, on the inside of the exterior sheathing. Then a fiberglass batt is installed over it.

The industry has known for years that airflow through insulation substantially reduces its effective R-value. Effective R-value is a term to describe how insulation performs in a real-world environment. The R-value of insulation stated by manufacturers is based from "guarded hot box testing" under ideal circumstances.

These tests do not take into account the heat scavenging effects of wind washing or air infiltration through walls that can substantially reduce performance of the insulation.

Wind washing is heat transfer by convection. When you go outside on a windy winter day, the best sweater in the world doesn't help much without a wind breaker over it. That's because the wind blows right through the sweater and scavenges heat. The same phenomena occurs in walls. The chart (above) shows that the air infiltration from a 5 mph wind reduces the effective R-value from 14 to slightly more than half of that.

Energy codes and programs like Energy Star go to substantial measures to make sure



The darker areas are the areas of greatest heat loss. This is an infrared scan of an insulated 2x4 wall.

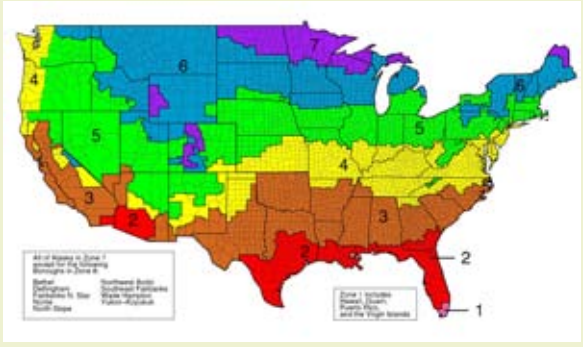
we perform air sealing around all the cracks and thermal bypasses to reduce air infiltration and exfiltration at the obvious air leaks. While sealing these areas are important, we are missing hundreds of linear feet of cracks and gaps at the perimeter of stud bays at plate lines and cavities. The infrared image (above right) illustrates the heat loss at plate lines and at the studs. Some of the heat loss is also due to thermal bridging. In a traditional fibrous insulated wall

Foam to the Rescue

Spraying ½" to 1" of closed cell spray foam in the stud cavity seals this area fast and economically. The foam efficiently expands to fill cracks and gaps around framing as well as mechanicals much faster and better than caulk sealant. It also seals narrow framing cavities that are almost impossible to seal with caulk or fibrous insulation. It is very durable and long lasting. In addition to the sealing closed cell spray foam has an R-value of 5.9 to 6.9 per inch allowing you get a greater total wall R-value than with traditional fibrous or cellulose insulation.

The use of spray foam does result in some compression of the fibrous insulation. The R-value of an R 15 batt compressed to 3" is about R 13. R 13 + 3.4 for the ½" foam gives you up to R -16.4. (Foam R-values vary by manufacturer.) If you spray 1" foam you could yield an R-19 wall in a 2x4 cavity. Add the

This picture illustrates not only the heat loss at plumbing lines but also airflow through the gaps at the lower plate line.



A climate zone map of the United States

Courtesy DOE

OSB and drywall and the entire wall assembly would be R-20.

Open or Closed Foam?

I think that open cell foam is an excellent insulation for full thickness applications. Like closed cell foam it does a good job of solving a lot of the thermal issues mentioned above. I do not recommend a ½ lb. density open cell product for the hybrid insulation system we are discussing for four basic reasons.

1. Open cell foam is difficult to spray on in a thin application.
2. It can compress when the fibrous insulation is installed over it.
3. Its R-value is about the same as fibrous insulation, 3.5 per inch.
4. It is fairly permeable and could allow moisture to pass through it to the sheathing in cold climates.

When it comes to moisture vapor flow into the cavity and the potential of moisture condensing on surfaces in cold climates, it is important to remember that the primary vehicle for moisture vapor movement into a wall cavity is airflow. That's air exfiltration and infiltration. Stopping airflow into the cavity eliminates the primary contributor to moisture vapor transport into wall cavities. Builders have used products like Tyvek for decades to reduce air infiltration and airborne moisture transport.

Colder climates zones 5–8 (and in some areas zone 4) codes require vapor retarders. For years many have practiced the ⅔ rule regarding placing the vapor retarder on the warm side of the insulation. So what is the impact of having a partial vapor retarder closer to the sheathing?

The good news is today we have reliable moisture modeling tools like WUFI from the Fraunhofer Institute in Germany. WUFI is a PC program that allows realistic calculation of the transient coupled one-dimensional heat and moisture transport in multi-layer building components exposed to natural weather.

I applaud CertainTeed Insulation www.certainteed.com and its building science department for doing the most detailed WUFI analyses I've seen for hybrid systems. This work gives us general guidance on the thickness of foam required based on the severity of the climate for hybrid wall systems.

For example if we are using a 2x4 hybrid system in climate zones 1–3, ½" of foam can be used with unfaced insulation. If we want to use ½" spray foam in climate zone 4–8, an interior vapor retarder is required. Their research shows us that if we are not using a vapor retarder in addition to the closed cell foam in climate zones 4 and higher this would require a 1" or thicker foam application.

Keep in mind this is general information, and field conditions can vary. CertainTeed does offer a custom hygothermal analyses. For more information contact a CertainTeed field representative.

In summary, hybrid insulation systems can substantially increase the thermal performance of your homes by reducing air exfiltration and infiltration.

This method also enhances the performance over traditional insulation by reducing the heat scavenging effects of wind washing that reduces its effective R-value at a reasonable cost. GB

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