

Case Study:
Scituate, Massachusetts

Building Type:
New Residential
Construction



Behind the Building:

Builder: Thomas P. McCarthy Builder
Independent Project Manager: Alice Brown
Home Size: 2,893 sq. ft.
Home Construction Type: Wood Frame
Climate Zone: 5

Dollars & Common Sense:

- One Year Annual Savings \$1,162*,***
- ~40% Reduction in Energy Consumption for Heating**
- 21.7 KBTU/yr. per sq. ft. of Heating Required***
- Estimated Payback <6 Years****

* Compared to a home built with fiberglass and a vented attic.

** Compared to 2005 DOE's Energy Information Administration (EIA) data on home energy usage in New England.

*** Based on a electricity rate of \$0.11/kWh and a natural gas rate of \$1.40/therm with home owner specified thermostat settings of 69°F in the winter and 75°F in the summer.

**** Based on a electricity and a natural gas cost escalation as forecasted by DOE's EIA.

A Lifetime of Value

CertaSpray™ Closed Cell Spray Polyurethane Foam (SPF) Helps Deliver Annual Energy Savings of \$1,162

Along the Massachusetts Coast, sits Scituate, a town known for its commercial fishing fleet, the Scituate Lighthouse and the Lawson Tower. Another thing Scituate is known for is its weather – mild during the summer, when temperatures tend to be in the 70s, and very cold and wet during winter, when temperatures tend to be in the 20s. When designing homes for this coastal town, builders must take into consideration the cold climate coupled with an average rainfall of 51 inches per year.

The key is to design homes with an air, vapor and thermal barrier around the home's exterior to keep out the wind, cold air and moisture. Homes need to be constructed as tight as possible, while maintaining proper ventilation mechanically. The homeowner elected to go with closed cell spray polyurethane foam (SPF) for his new home construction, as it was the best product to provide a robust air, vapor and thermal barrier.

"SPF acts as an air-tight shield around the exterior of the home. This prevents air, moisture and dampness from entering, and helps keep the home extremely comfortable," said Alice Brown, independent project manager.

During construction, six inches of CertainTeed CertaSpray™ Closed Cell Foam, R-38, were applied directly to the underside of the roof deck to create an unvented attic assembly. Four inches of CertaSpray Closed Cell Foam, R-25, were applied in the wood frame wall cavities, while six inches of closed cell SPF, R-38, were applied between floor joists.

In all three areas, closed cell SPF's superior R-value allowed the homeowner to achieve higher R-values (in the same size cavity) than would have been possible with traditional fibrous insulation. The closed cell SPF also provided the water vapor retarder required in Northern climates, in this case Climate Zone 5. To complete the spray foam air barrier system, low-expansion, one-component foam and latex caulk were used to seal rough opening voids, seams and joints.

This exceptional building enclosure helped the home to achieve a HERS index of 64, meaning the home is expected to use 36% less energy when compared to a home built to the 2004 IECC. Given that a typical home uses ~40% of its energy on space heating and cooling, this is a remarkable achievement. The modeled energy consumption for heating was 40% less than the average New England home as reported by the EIA's Residential Energy Survey.

Air Tightness

One of the primary reasons this home is so energy efficient is air tightness. A certified HERS rater found 2.4 air changes per hour @ 50 Pa when measured using a blower door test. This translates to ~ 0.18 NACH (natural air changes per hour) for this two-story exposed home, meaning approximately 18 percent of the home's air volume will be replaced every hour via air infiltration. With the spray foam air barrier, the Scituate House allows 80% less air infiltration when compared to new homes built between 1993 - 2002. (Refer to the Blower Door Measurements chart.)

Additional Cost	
Insulation (SPF minus FG cost)	\$8,704
HRV	\$1,700
Cost Savings	
A/C Size Reduction	\$1,550
Furnace Size Reduction	\$825
Vapor Retarder Elimination	\$650
Sum	\$7,739
1 Yr Annual Savings*, **	\$1,162
Estimated Payback****	< 6 yrs

By building a tight home, the need to condition all the external air that infiltrates normal homes was nearly eliminated, thus drastically reducing energy usage for heating and cooling. To meet ASHRAE Standards, controlled mechanical ventilation was added to the home using a heat recovery ventilator (HRV). By controlling air infiltration, unwanted allergens and pollutants, e.g., pollen and dust, and sound stay out of the home improving indoor air quality. Lastly, the air tight, properly insulated wall assemblies prevent internal moisture from making its way to the cold exterior surface, condensing, and then causing mold or rot.

Downsizing HVAC Equipment

Less air changes per hour also mean that the heating, ventilating and cooling (HVAC) equipment have a lot less work to do. The general rule-of-thumb for HVAC

HVAC Requirements

Rule of Thumb...5-ton A/C Unit; 145,000 BTU/hr Heating Unit
With SPF2-ton A/C Unit; 32,000 BTU/hr Heating Unit

equipment in Massachusetts is 1 ton of cooling capacity per 600 square feet and 45-50 BTU/hr per square-foot of heating capacity. With the rule of thumb, this home would require a 5-ton air conditioning unit and a 145,000 BTU/hr heating unit. Because SPF significantly reduces infiltration of unconditioned air, the heating and cooling design loads of this home are significantly smaller than the rule of thumb.

A Manual J HVAC load calculation was performed to determine the proper size for the HVAC equipment. Right sizing HVAC equipment is critical to prevent short cycling, which can affect comfort, reduce energy efficiency, limit A/C dehumidification capacity and shorten equipment life. For this super tight, well-insulated home, the appropriate sizing for the HVAC equipment was 2 ton of A/C and 32,000 BTU/hr of heating. As with any tight home, the combustion appliances installed utilized sealed combustion air to prevent flue gas spillage into the home and backdrafting.

Economics

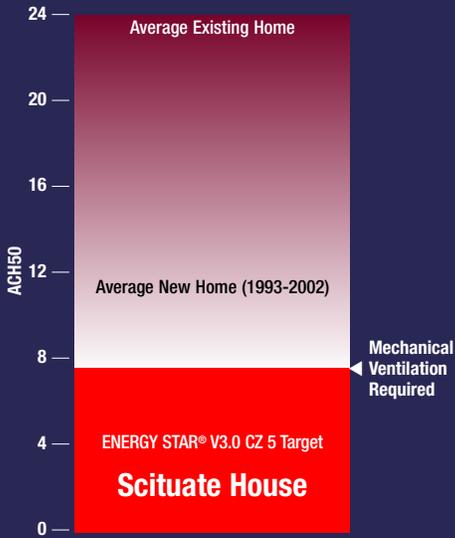
Not only does SPF save energy, but it also saves money. The home was modeled with SPF and fiberglass using 2009 IECC R-value requirements, (slightly lower than the as-installed R-values). Energy models estimated \$1,162 savings per year, resulting from utilizing SPF and an unvented attic compared to utilizing fiberglass and a vented attic. Natural gas accounted for \$1,245 in savings. The annual electricity usage was \$83 higher in the SPF case, due to the HRV fan usage (this was offset by lower A/C usages). The overall savings resulted from large reductions in air infiltration, bringing ducts inside conditioned space, and higher quality installation of insulation*.

The incremental cost of adding spray foam to this house, rather than fiberglass, was estimated at \$7,739. The \$1,162 annual savings were escalated based on Department of Energy's Energy Information Administration forecasts. Based on this model, the projected simple payback is less than 6 years, considerably better than many other energy efficiency measures.

Conclusion

CertaSpray Closed Cell Spray Foam will provide a lifetime of the value to the homeowner in both energy savings and comfort. This well-built home will not only save approximately \$100/month in energy bills, but it will also insulate the owner's wallet from further rises in electricity and natural gas costs. When designed properly with sealed-combustion appliances and mechanical ventilation, the indoor air quality will far exceed that found in homes without air barriers. Perhaps most importantly, sealing off the harsh environs of the cold and wet Massachusetts coasts with a continuous air barrier and vapor retarder, such as SPF, will ensure the home will be durable enough to be enjoyed by generations to come.

Blower Door Measurements



The blower door measurements are used to set shell leakage standards and compare homes to one another. (Assumes an n-value of 20)

Source: Air Tightness of New U.S. Houses: A Preliminary Report



Unvented attic assembly with intumescent coating ignition barrier.

Huntsman
10003 Woodloch Forest Drive
The Woodlands, Texas 77380
281-719-4602
sprayfoam@huntsman.com
www.huntsman.com/sprayfoam

* SPF case utilized as-tested blower door results and assumed Class I grade installation. Fiberglass case utilized 11 ACH₅₀ and assumed Class III grade installation. Ducts were assumed to leak to the outside at the code required 12 cfm/100 sqft post construction at 25 Pa.

CertaSpray™ is a trademark of CertainTeed Corporation. ENERGY STAR® is a registered trademark of the U.S. Environmental Protection Agency.

Disclaimer: Huntsman makes no guaranties, warranties or representations (intended or implied), as to the correctness of any information or any recommendations or to the merchantability, suitability or fitness of any product for any particular use or purpose.