

Case Study:
Beverly, Massachusetts

Building Type:
New Residential
Construction

A Study in Sustainable Living

Spray Polyurethane Foam Lays the Foundation for a Cutting-edge, Sustainable Home



Behind the Building:

Home Size: 4,600 sqft
Home Construction Type: Wood Frame
Climate Zone: 5
Builder: Cleantech Homes
Energy Auditor: Reclaimed Energy

Common Sense:

- Building enclosure was first priority
- SPF facilitated super-tight construction
- SPF contributed to LEED® credits

When Cleantech, a green residential development and consulting company, began conceiving a sustainable showcase home, its top priority was to reduce energy usage in both a sustainable and aesthetically-pleasing fashion. Cleantech built a strong foundation for sustainability by first designing a building enclosure that would stand up to the heating demands in New England.

Cleantech's showcase home boasts the most cutting-edge sustainable products currently available. It was designed not with disparate sustainable components, but with a systems approach, ensuring that sustainable elements work together. This home features geothermal energy, solar photovoltaic panels, solar thermal hot water, and sustainable materials throughout.

Each of its sustainable products contributed to the home's LEED® Platinum Home rating application, but the home's building enclosure laid the foundation for achieving a high level of energy efficiency. "A closed cell spray polyurethane foam (SPF)

thermal and air barrier system created an air tight home, minimizing heating and cooling cost from air infiltration, which leads to significant energy losses," said James Farnham, President, Cleantech. Cleantech understood that the cutting-edge technologies employed to provide energy to the home only made sense once the energy load on the home was minimized in an economical fashion. Energy efficiency starts with the building enclosure.

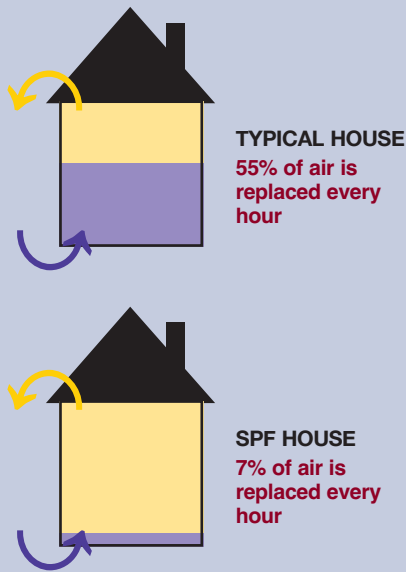
The Building Enclosure

Cleantech knew closed cell SPF was the best insulation for creating a tight building envelope, and chose CertainTeed's CertaSpray™ Foam Insulation, which is based on Huntsman's technology. Cleantech chose CertaSpray SPF not just for its exceptional R-values and reputation for performance, but also for the structural qualities, moisture vapor retarder and air barrier that closed cell foam provides. Much more than just insulation, SPF offers improved building durability, healthy indoor air quality and enhanced moisture management — all critical factors in building quality homes.

CertaSpray's closed cell foam insulation was applied in the wall cavities, the underside of the roof deck, on basement walls, and in frame floors over the garage and porch to protect the home against heat, cold, air infiltration, moisture and sound.

An additional benefit was the reduced lumber usage that closed cell SPF enabled. Use of SPF helped Cleantech to utilize 2X4 framing, while still achieving its targeted high R-value. In addition to reducing lumber usage and costs, 2X4 framing helped Cleantech save on window and door extension jambs and provided additional square footage.





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

HVAC Equipment Requirements

Air Conditioning Unit

Rule-of-Thumb7.5-ton unit

Actual3-ton unit

Heating Unit

Rule-of-Thumb250,000 BTUs per hour

Actual70,000 BTUs per hour

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Air Tightness and Indoor Air Quality

Air tightness was a significant factor in reaching the energy efficiency goals. Ted Staples, a certified HERS rater from Reclaimed Energy, found the home's air tightness to be much better than typical construction. SPF creates an excellent air barrier system, positively impacting energy efficiency, reducing condensation potential, and improving air quality in the form of reduced allergens, pollutants and noise.

A blower door test found an air infiltration rate of ~ 0.07 NACH (natural air changes per hour), meaning roughly 7% of the home's air volume is replaced hourly via air infiltration. A typical home built in 2002 - 2003 has roughly 55% of its air volume replaced hourly with unconditioned outside air. Each cubic foot of air that enters via infiltration must be heated/cooled to get the house back to its thermostat set point. Thus, SPF has a very significant impact on energy efficiency by minimizing infiltration of unconditioned air.

Although the home is tightly constructed, the indoor air quality of the Cleantech home is excellent, with balanced ventilation provided through heat recovery ventilators (HRVs), passing through a filter before entering the home. This allows control of the air exchange with the outside rather than allowing unknown amounts of outside air to enter the home carrying along allergens, moisture and noise. The HRVs recover energy from the exhausted air to provide this controlled air exchange in an energy efficient manner.

Rightsizing Heating & Cooling Systems

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 for HVAC equipment in Massachusetts.

Achieving LEED's Highest Certification

LEED assigns points based on energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. SPF provided valuable points in several areas for Cleantech's pursuit of LEED Platinum certification for this home.

SPF contributes LEED points in the Energy category in three ways:

- High quality insulation
- Air tightness, typically 0.05 - 0.20 NACH for SPF homes
- Design flexibility to easily accommodate ducts in conditioned space

However, SPF can also contribute in less obvious ways. In the Materials and Resource category, closed cell SPF can assist in achieving points for material efficient framing. Not only did the high R-value of closed cell SPF allow 2X4 stud members, the structural properties of the foam increase racking strength and facilitate use of wider structural member spacing. CertaSpray closed cell foam is also GREENGUARD Children and SchoolsSM certified and meets the testing requirements to get credit for a low emitting material. Lastly, it can contribute to protection from garage pollutants for credit in the Environmental Quality category.

Conclusion

Cleantech's home is truly a cutting-edge home when it comes to sustainability. In fact, the HERS rater found that this home will use 60 to 70% less energy than a home built to code. The home is currently being utilized as a teaching center that showcases sustainable building techniques and design, as well as new products and construction materials used in high-performance homes.