Net-Zero Project's Unique Use of Spray Foam

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by by Rick Duncan, Ph.D., P.E

Zero Net Energy (ZNE) will soon be the overriding goal driving the residential building industry.

Over the past decade, interest and activity in ZNE have markedly increased. More and more custom homes designed for ZNE have cropped up, and many production builders are currently planning ZNE new home communities, even if those communities represent their first endeavor in the space. Pre-fab options are also gaining traction, and the movement overall has grown in momentum, with ZNE project case studies and solutions now figuring more prominently in industry conferences.

Net zero momentum

"The net-zero building movement is rapidly gaining momentum -- the number of net-zero energy buildings nationally is on a steep upward curve and has increased 700 percent since 2012, " said Drew Shula, founder and principal with Verdical Group and organizer of the Net Zero Conference held annually in Los Angeles, which is expected to draw close to 1,000 attendees in September. "Just as the LEED green building rating system took off on a trajectory up and to the right about 15 years ago, the net-zero building movement is poised to do the same in the decade ahead."

Within the residential sphere specifically, some standout projects were delivered to market this past year. One such home, the Jacobson House in Northern California, garnered the spotlight with its unique story and innovative energy solutions.

The home belongs to Stanford professor Mark Z. Jacobson. His commitment to living in an Earth-friendly home aligns with his role as head of the university's Atmosphere and Energy Program. A climate and clean energy scientist, Jacobsen is also one of the founders of The Solution Project, a program to accelerate the transition to 100 percent renewable energy use in the United States. His new home enables him to practice what he preaches.

The home sits on an irregular pie-shaped lot near Stanford's campus. An abode designed by BONE Structure, the Canadian prefab homes company, the Jacobson house has been compared to a giant erector set. Snapped together in under a week, the 3,200-square-foot modular home includes a frame comprised entirely of steel, of which 89 percent of the material used is sourced from recycled content and is expected to last centuries longer than a wood frame.

The home is also designed to use no consumer electricity and generates zero emissions. Powered by solar panels, all excess energy is stored in large Tesla batteries. There is no natural gas line leading into the property.

"This home is exciting for a variety of reasons including its tie to a world-class scientist, its unique prefab construction and its overall energy generating technology and performance," said Kurt Riesenberg, executive director of the Spray Polyurethane Foam Alliance, one of the sponsors of the Net Zero Conference. "The most exciting part of this to me, however, is how the project uses spray polyurethane foam insulation to conserve the energy. The SPF industry has always contended that there is no better compliment to distributed or onsite energy generation than spray foam. Who wants to invest in technology and engineering just to put it in service on a building that leaks like an air-filter?"

The home's metal framing provides improved structural performance for the walls. While somewhat typical in commercial construction, metal framing can create unwanted thermal bridging. But in this home, horizontal framing was applied perpendicular to vertical framing to minimize heat loss through metal studs, while maintaining a fastening surface to the exterior cladding.

The area between the horizontal and vertical horizontal studs was insulated and air sealed with spray polyurethane foam insulation, in an approach consistent with high-performance walls as emphasized in the state of California's 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (i.e., Title 24).

SIPs were used for the low slope roof structure. While SIPs provide continuous insulation, they must be properly sealed at all joints and wall connections. Open-cell spray foam applied below the roof deck provides backup insulation and air sealing for the SIP roof structure.

Airtight thermal envelope

The building enclosure for this home measures an air leakage rate of 0.8 ACH50, which is extremely low. Minimizing unwanted air movement through the enclosure reduces exfiltration of conditioned air and infiltration of unconditioned air, which reduces energy use for heating, ventilation and air conditioning. Jacobson reports a 90-percent reduction in HVAC operating costs, enabling him to sell up to two-thirds of the onsite energy generation back to the local power companies. The minimized air leakage also provides the added benefit of improved indoor comfort and air quality by controlling moisture and eliminating infiltration of outdoor pollutants and allergens.

SDI Insulation, Inc., a well-known Northern California based insulation contractor, completed all spray polyurethane foam installations in the home, using Accella Bayseal open-cell spray foam on the underside of the roof panels. They also applied Accella Bayseal closed-cell spray foam to the outside of the exterior walls, providing extra R-value, air sealing and structural strength, while creating a rain screen behind the exterior cladding system.

The air-tightness of the exterior walls also minimizes transmission of outdoor noise into the home, while the open-cell spray foam used inside the home's interior walls reduces sound transfer between rooms.

"We install spray foam insulation in a number of high-performance homes and structures and know the power of the material in maximizing energy efficiency," said Steve DeLorenzi, principal and owner of SDI Insulation. "The Jacobson home, however, showcases how well spray foam complements energy generation technologies such as solar, to create a total energy solution for the home, which in this case is Net Zero Energy."

The Jacobson House and SDI Insulation were recently recognized with a 2018 Industry Excellence Award, winning first prize in the Residential Wall category. The annual awards program recognizes best-in-class spray polyurethane foam projects in insulation, roofing and specialty applications, and is hosted by the Spray Polyurethane Foam Alliance (SPFA), the technical and educational resource to the spray foam industry.

"The SPFA has been a major proponent of the Zero Net Energy movement for quite some time now, as spray foam technology is particularly well suited for ZNE structures," added Riesenberg. "We are really proud to witness the growing activity among our members and the industry at-large in Zero Net Energy homes, and we expect to see more and more ZNE projects built in the coming years that will capitalize on spray foam's unique multitude of performance deliverables."

About the Author

Rick Duncan, Ph.D., P.E is the Technical Director of the Spray Polyurethane Foam Alliance (SPFA), the industry's leading organization representing contractors, material and equipment manufacturers, distributors and industry consultants. The SPFA promotes best practices in the installation of spray foam and offers a Professional Certification Program to all those involved in the installation of the product.