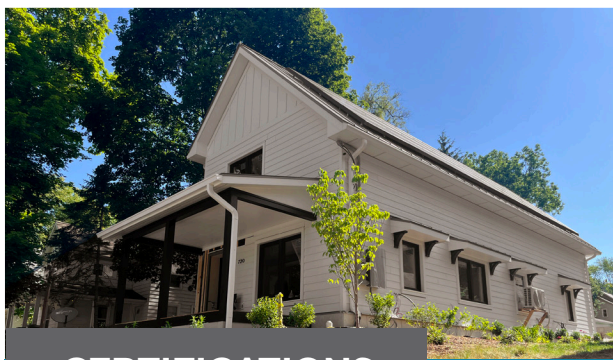




Ready to Stand up to West Winds

Net Zero House Built with Climate® NS



CERTIFICATIONS

- Phius Zero Certified
- DOE ZERH Certified
- GreenStar Platinum Certified
- LEED Platinum Certified
- Energy Star Certified
- EPA Indoor airPLUS Certified
- EPA Water Sense Certified

UNIQUE STRUCTURAL FEATURES

- Wood foundation built over pea gravel and foamed glass aggregate to maximize protection against moisture and frost
- Enhanced wind resistance utilizing Climate NS adhesive throughout the wood frame
- Extended south-facing roof to accommodate solar panel array sufficient to meet energy demand of house and EVs
- Low-embodied carbon materials



MiNet0-1 Grand Rapids, Michigan

Overview

In the summer of 2024, innovative builder, Dale Hulst, began construction on a net-zero home designed to meet multiple certifications. Because the 1,510-square-foot shotgun structure was built on a lot facing strong west winds, Hulst's crew utilized Climate® Non-Slump (NS) Adhesive throughout the frame, including foundation, flooring, walls, trusses, sheathing, and roof deck.





Foundation and Subfloor

The foundation, which may be the first of its kind in the U.S., eliminates concrete and foam, both carbon-intensive materials. Instead, Hulst began with a shallow excavation and covered it with geotextile, which prevents sand mixing with the next layer of foamed glass aggregate. This serves as the insulation layer, delivering an R32 factor. Next came a 15-mill polyolefin vapor barrier, then a shallow wood footing system around the perimeter, secured to the ground with sixteen 46-inch earth anchors. The footing was built with KDAT lumber because it is more stable than wet lumber and reduces the amount of moisture that needs to be dried out of the structure. The footing and floor area were filled with pea gravel. Hulst's team screed and compacted the gravel to create a solid, flat surface which supports the subfloor. Hulst calls this a "slab-less slab," meaning it functions as a slab but eliminates the use of concrete. The subfloor is composed of two layers of $\frac{3}{4}$ -inch tongue and groove plywood, which "floats" on the pea gravel. Half sheets were used in the first layer to ensure that there were no overlapping joints. Cli-





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mate NS was applied where the floor attaches to the wood footing system and between the two layers.

Hulst notes that this shallow foundation design is frost-protected with mineral wool insulation around the perimeter in addition to the foamed glass aggregate below. The pea gravel helps to keep the floor system dry, adding that he could have used a more conventional approach of limestone chips instead of pea gravel, but the latter provides superior breathability. “If water ever gets into the system, it has an avenue for escaping.” In addition to using Climate NS to bond the plywood used in the footing, Hulst’s crew applied adhesive around the sixteen screw heads to protect against moisture.





“A passive house is all about energy and durability, but it’s also about a healthy house, and you get that by making sure there are no leaks in the envelope and therefore no entry for pollen and mold. It’s also about using materials that don’t outgas VOCs and unlike other adhesives, Climate has very low VOCs.”

Walls

Hulst chose a double wall design to maximize strength and minimize thermal bridging. Both walls are constructed with 2x4s with 9½-inches of space between them. The exterior wall and cavity between the walls are packed with TimberFill insulation. The interior wall functions as a service cavity for plumbing and electrical, protects the primary vapor barrier, and is filled with TimberBatt insulation. This wall system achieves R59. The assembly features a double membrane system with Intello intelligent vapor barrier on the inside 2x4 wall and Mento® Plus on the outside. The Mento functions as a secondary air barrier and water-resistant membrane that prevents moisture from getting into the insulation. Hulst notes that when designing an envelope system, care must be taken to avoid trapping water vapor. Intelligent

vapor barriers adapt to humidity keeping it from rising above 80 percent within the wall. The dual membrane system also enables an incredibly tight structure which provides superior energy efficiency, durability, and building health.

To eliminate potential condensation surfaces, no sheathing was used on the south and north walls, but plywood sheathing was used for shear strength on the narrower east and west walls where high winds occur. It was installed (with nails and Climate NS) on the interior wall so that it would not experience high humidity conditions. The second floor was built on a plywood subfloor bonded with Climate NS and screwed to the floor truss. The truss spans the width of the house with no interior bearing walls. These are a helpful alternative to traditional stick-building with floor joists because they can be designed for longer spans, and the open web design accommodates mechanical, electrical, and plumbing pipes more easily.

Climate NS was used throughout the frame including all plywood and plate connections. Hulst states that he is counting on Climate NS to “not only reinforce the structure and protect the house against wind damage, but also to make sure the floors never squeak for the life of the house.” Hulst also notes that the non-toxic features of Climate NS are a further benefit: “A passive house is all about





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The roof deck is built with 5/8-inch plywood and Climate NS was applied under the plywood before nailing with 3¼-inch nails that penetrate through the 2x2s into the truss.

Roof

The roof was constructed without rafters and traditional bird mouth joints. Instead, engineered open-web trusses sit flat on the 2x4-foot plates on tall “energy heels.” Blocking placed between trusses adds strength and resistance to wind loads. Because Hulst wanted to maximize the south-facing roof area to generate more space for the solar array, the truss cuts into the second floor producing a knee-wall effect on the south side of the second-floor rooms. 2x2s create a vented roof deck above the Mento membrane on the top of the truss. The roof deck was built with 5/8-inch plywood, and Climate NS was applied under the plywood before nailing with 3¼-inch nails that penetrate through the 2x2s into the truss. Hulst chose a standing seam steel roof for its 50-year projected life span. A solar array consisting of 32 panels is mounted on clips that attach to the standing seams without penetrating the roof.



Final Assessment

All in all, this house is a model for how buildings can be constructed in the future, now. It provides superior energy efficiency, significant health benefits, and a smart energy system that enables sustainable, resilient life. Hulst designed the home to be capable of generating sufficient electricity to meet all its energy needs as well as power two EVs. The grid connection allows extra power generated in the summer to be sold and power during dark winter weeks. On-site batteries, smart circuit breaker panels, and a vehicle-to-home connection enable “always on” capability for all home functions as well as “grid-beneficial” power man-

And because Climate NS “holds it all together,” those benefits can be preserved in the event of violent storms.

agement. In addition to its on-site power plant and innovative structural features, this Grand Rapids home includes water-saving fixtures, health-certified materials, and native plant landscaping requiring minimal watering. And because Climate NS “holds it all together,” those benefits can be preserved in the event of violent storms.



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