Casita de Vida

Holyoke, Massachusetts

PROJECT SNAPSHOT

Development Type: Single story single family, 600sqft

Completion Year: Permitted in 2025, currently nearing completion in 2026

Developer/Owner: Greater Springfield Habitat for Humanity

Architect/Designer: UMass Design Build Program

Verifiers: HERS Rating: Lia Douillet; BEAM Rating: Diana Andrea Brito Picciotto

Mechanical Systems Designer: L. Carl Fiocchi (MEP Systems)

Structural Engineer: Leonard Morse-Fortier

Code Pathway: Permitted under the Stretch Energy Code (225 CMR 22.00) with compliance demonstrated via the HERS rating pathway

Casita De Vida rendering — front of house.
Final Presentation, UMass DesignBuild Studio

PROJECT OVERVIEW

Casita de Vida is a 600-square-foot modular housing unit developed as a compact, **all-electric** residence. Although typologically an accessory dwelling unit (ADU), the building was permitted as a single-family home. The project was developed through the UMass DesignBuild program at the University of Massachusetts Amherst. Since 2020, the program has integrated **design education with hands-on construction**, engaging students in the full project cycle of a residential project, from concept development through construction.

Within the academic studio setting, students developed the architectural concept, conducted **energy modeling**, coordinated with consultants including a structural engineer, and worked with a **certified HERS rater** to verify **performance targets**. Casita de Vida demonstrates how small-scale housing can achieve strong energy performance within a replicable modular construction framework.

The unit was designed for off-site modular construction, highway transport, and compliance with **Massachusetts modular certification requirements.** Casita de Vida was installed in Holyoke, Massachusetts, in partnership with the Holyoke Housing Authority, Greater Springfield Habitat for Humanity and the UMass Design Build Program.

Design & Construction Approach

Construction of Casita de Vida occurred on the UMass campus as an off-site construction project before the completed unit was transported and installed in Holyoke, Massachusetts, in partnership with Greater Springfield Habitat for Humanity.

Design & Construction Approach (cont.)

This approach enabled inspection and approval through the Massachusetts state modular building program, a third-party inspection and certification process administered by the Massachusetts Board of Building Regulations and Standards, streamlining oversight during framing and enclosure stages, and illustrating a **replicable pathway for high-performance modular housing delivery.**

Envelope

The **wall assembly** is constructed using a **double-stud** configuration, creating a 10-inch cavity filled with dense-packed cellulose insulation. This assembly is sheathed with plywood structural sheathing and 3/4-inch exterior cladding on a rainscreen and finished on the interior with a smart vapor membrane and interior drywall. As part of a student-led material exploration, **18-inch-thick straw bale insulation panels were installed** in a small portion of the structure, exposing students to bio-based construction methods while reinforcing the project's emphasis on reduced embodied carbon and high thermal performance. **Triple-pane** fiberglass-frame windows are integrated throughout, supporting airtightness and overall energy efficiency.

The **foundation** utilizes a conventional concrete wall assembly with polyiso insulation on the interior face. The slab-on-grade assembly in the basement incorporates sub-slab insulation. While the concrete components contribute significantly to embodied carbon relative to the wood-framed superstructure, they provide structural durability, thermal mass, and continuous insulation at the foundation level.

Mechanical Systems

A ductless air-source heat pump provides space heating and cooling. A heat recovery ventilator (HRV) delivers continuous balanced ventilation, recovering heat from exhaust air to maintain indoor air quality and minimizing energy losses. Domestic hot water comes from a heat pump water heater (40-gallon tank), which extracts heat from ambient air to heat water more efficiently than conventional electric resistance systems. Hot water piping is insulated to reduce standby losses and improve distribution efficiency.

Casita De Vida renderings
Final Presentation, UMass DesignBuild Studio

Performance Results

Assembly/System	Material	Metric	Value	Notes
HERS Rating	NA	Index	**Preliminary modeled HERS:** 28 **Final HERS:** 32	HERS index targets for ADUs range from 52 to 58 under both the Stretch Code and the Specialized Code, depending on energy system and on-site renewable generation.
Walls	Double stud w/ dense-pack cellulose	R-value	R-37	
Foundation Walls	Polyiso	R-value	R-20	Conditioned basement
Ceiling	Dense-pack cellulose (flat ceiling)	R-value	R-73.9	Flat ceiling, high insulation
Slab	Expanded Polystyrene	R-value	Under slab: R-10 Edge insulation: R-13	
Windows	Triple-pane glazing	U-value / SHGC	0.220 / 0.240	
Heating	Air-source heat pump	HSPF	13.8	Mitsubishi MUZ-FS12NAH
Cooling	Air-source heat pump	SEER	29.9	Mitsubishi MUZ-FS12NAH
Ventilation	Heat recovery ventilator	CFM / Watt	29cfm / 7.0 watts	Lunos
Water heater	Heat pump water heater	EF	4.03	Stiebel Eltron Accelera 40-gallon tank

Embodied Carbon Analysis

A central goal of this project was to help students understand that every material input carries an **embodied carbon impact**. Using BEAM (Building Emissions Accounting for Materials) emissions modeling, the team quantified the greenhouse gas emissions associated with material extraction, manufacturing, transportation, and installation.

The project achieved **74 kgCO2e/m²**, compared to an estimated **184 kgCO2e/m² for a typical new home**, as projected by UMDB. This represents a substantial reduction in material-related carbon intensity relative to conventional residential construction.

The net total embodied carbon for the project was **14,465 kg CO2e**. For context, 630 kg CO2e is approximately equivalent to flying 939 miles from New York to Orlando, and 64 kg CO2e is roughly equivalent to driving 100 miles.

Embodied Carbon Analysis (cont.)

In this project, the use of **biogenic insulation materials** such as dense-pack cellulose, straw bales, and wood fiber-based insulation contributed to measurable carbon storage within the building envelope, reflected in the **negative embodied carbon value for the exterior wall assembly (-241 kg CO2e)** shown in the table. These materials meaningfully reduce the overall footprint and demonstrate how assembly-level decisions can influence total emissions. By quantifying emissions at the assembly level, the project reinforces that high-performance construction is not only about reducing operational energy use, but also about making deliberate material choices that reduce upfront carbon impacts.

Material Carbon Emissions by Section

Footings & Slabs	3,983 kg CO_2e
Foundation Walls	6,914 kg CO_2e
Structural Elements	0 kg CO_2e
Exterior Walls	-241 kg CO_2e
Party Walls	0 kg CO_2e
Cladding	817 kg CO_2e
Windows	874 kg CO_2e
Interior Walls	265 kg CO_2e
Floors	726 kg CO_2e
Ceilings	212 kg CO_2e
Roof	914 kg CO_2e
Garage	0 kg CO_2e
NET TOTAL	14,465 kg CO_2e

Darling, Naomi, and Garth Schwellenbach. "Embodied Carbon Calculations as a Design Tool in the Adaptive Reuse of a Campus Building." Proc. 6th Int. Conf. on Structures and Architecture, Antwerp, Belgium, July 8–11, 2025, pp. 446–453

Cost Insights

Estimating the total cost for Casita De Vida is difficult due to the number of donated materials from partners and community members. The project benefited from a combination of donations, fundraising, and discounted supplies from a local building supply company, as well as some financial contributions from collaborators. However, the property was **appraised at just under $300,000**. A detailed internal estimate, including purchased and donated materials, transportation, consultants, and staff time, comes in slightly below this value, though it does not include student labor. Small buildings naturally have higher costs per square foot, which is reflected in this project.

Legal and financial barriers to ADU construction have changed, but challenges remain. Casita De Vida demonstrates both the opportunities and limitations of building small ADUs in Massachusetts. Under **recent statewide law** (Chapter 150 of the Acts of 2024), units up to 900 square feet can be built in single-family zoning districts without discretionary zoning approval, provided they meet standard building codes and permitting requirements. In many cases, traditional lenders have not structured financing products that treat future ADU rental income as qualifying income, making it difficult for homeowners to secure conventional construction loans and often forcing them to rely on alternative financing approaches.

"I think the legal barriers to ADUs are dropping, but the financial barriers remain the largest, the most significant barriers because they're relatively expensive." - Robert Williams (Assistant Professor University of Massachusetts Amherst)

From a broader housing system perspective, small homes such as ADUs, particularly when permitted and constructed to meet current energy and safety codes, represent an important incremental tool in addressing local housing shortages.

"There haven't been as many built, as quickly as I think people would have hoped, and that's really due to cost."
- Naomi Darling (founding principal of Ko-LAB Architecture and Five College Associate Professor of Sustainable Architecture)

Outcomes & Lessons Learned

Design Build Program Evolution & Design Approach

Since its inception, the UMass DesignBuild program has prioritized energy-efficient and low-carbon construction while educating students about high-performance building practices. Over the past six years, the program's focus has evolved from primarily operational energy efficiency to include **embodied carbon**, reflecting a growing emphasis on the environmental impact of building materials.

The program has tested and iterated various wall assemblies and insulation strategies to balance energy performance, carbon impact, and student buildability. Early experiments with wood fiberboard presented installation challenges, leading the team to adopt double stud wall construction with dense pack cellulose insulation in recent builds. These approaches allow for high-performance outcomes, strong HERS ratings, and effective hands-on learning for students.

Project Outcomes & Key Takeaways

Casita De Vida demonstrates several key lessons for future ADU projects. The modular construction approach, including third-party inspections, enabled compliance with state building requirements and ensured quality control for the off-site build. Iterating the assembly and construction methods over multiple builds resulted in a configuration that balances performance, and ease of construction, with strong HERS performance for an all-electric ADU.

The educational impact has been a major outcome of the project. Naomi shared that:
"Even though the houses that we're building are small, I feel like the impact of going through this experience for the students is really significant and will impact every future project that they work on, either as an architect or working in the construction fields."

Special Thanks to:
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Naomi Darling, founding principal of Ko-LAB Architecture and Five College Associate Professor of Sustainable Architecture, and Robert Williams Assistant Professor at University of Massachusetts, Amherst

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