



# Park Hill Residence

Northampton, Massachusetts

## PROJECT SNAPSHOT

**Development Type:** Single Family Home

**Completion Year:** 2026

**Owner:** Karen Randall

**Architect/Designer:** Ko-LAB Architecture, Principal: Naomi Darling

**HERS Rating:** Powerhouse Energy Consulting

**Contractor:** Wright Builders, Seth Lawrence-Slavas

**Structural Engineer:** Leonard Morse-Fortier

**Code Pathway:** Stretch Energy Code (780 CMR Appendix AA)

## PROJECT OVERVIEW

The Park Hill Residence and Studio is a high-performance **single-family home** on a steep, previously undeveloped site in Northampton, Massachusetts. The project was developed in collaboration with homeowner Karen Randall. Architectural design was led by Naomi Darling, construction was managed by Seth Lawrence-Slavas and HERS rating and performance verification services were provided by Powerhouse Energy Consulting.

Designed as an all-electric, **net-zero residence**, the project integrates [passive design strategies](#), a high-performance building enclosure, and **on-site solar generation**. While not formally certified under Phius nor Passive House Institute, the design incorporates core Passive House principles as part of a performance-based approach to high-efficiency residential design, including optimized solar orientation, a highly insulated and airtight enclosure, high-performance glazing, balanced ventilation with energy recovery, and reduced heating and cooling loads through passive design.

A dedicated artist studio (400 sq ft) is connected to the main living area (1500 sq ft) through a transitional indoor garden court, creating separation between living and working spaces while remaining within the thermal envelope. The home reflects a strong commitment to energy efficiency, low embodied carbon, and occupant health and well-being, grounded in a broader long-term investment in resilience, durability, and quality of life.

Northampton is a Stretch Energy Code municipality, and the project was submitted for energy incentives in June 2024, just prior to the July 1, 2024 update to the Massachusetts Stretch Code. At the time of permitting, the required HERS Index was 52.



*Naomi Darling Architecture, Randall Design Process*

## Project Overview (cont.)

The project's projected HERS score was approximately 40 based on conservative modeling assumptions, suggesting the home was expected to use about 60% less energy than a reference home. This performance outperforms both the pre-update requirement and the current Stretch Code range of approximately 42 to 45.

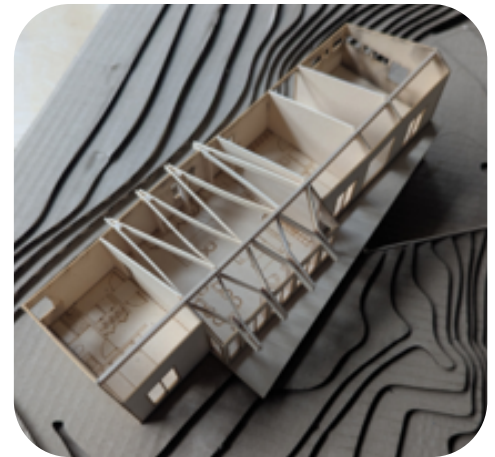
Beyond stretch code compliance, the project has been designed to achieve multiple high-performance certifications, including **ENERGY STAR NextGen**, **Indoor airPLUS (IAQ+)**, and **Watersense**.

## Design & Construction Approach

The design approach for the Park Hill Residence and Studio prioritized **passive design principles** from the earliest stages of site analysis and early building design. From the outset, the project team evaluated solar orientation, prevailing winds, and site topography to inform the building's placement and form. The steeply sloped site, which had previously limited development potential, also offered expansive views of the Holyoke Range that strongly influenced the orientation and spatial organization of the house. A central goal was to create a highly energy-efficient, net-zero residence while simultaneously considering strategies for reducing embodied carbon.

The house's sustainable design began with passive principles: understanding the site, the path of the sun, and the movement of air before relying on mechanical systems. Early decisions focused on how to work with the terrain, where to locate the driveway, and how to orient the building to support on-site photovoltaic generation capable of achieving net-zero performance.

The project also reflects a broader environmental ethic. As Naomi Darling explains, *"Every project, whether it's a new building or an adaptive reuse, is an opportunity to make our built environment better for the climate. Every building is an opportunity to consume less."*



Naomi Darling Architecture, Randall Design Process

Equally important was the relationship between environmental performance and **quality of life**. The integration of the studio and garden court supported both functionality and daily experience, while attention was given to sensory comfort through natural light, access to outdoor space, quiet interiors, and connection to surrounding ecology. Large south-facing openings connect the home to the deck and landscape, while the site's biodiversity and views contribute to occupant well-being.

*"[In my previous home I could] hear my heating ventilation system kicking on... there's always background noises that we get used to. On the other hand, maybe they're adding some kind of stress... just like tiny little environmental stresses that make a difference."* Karen Randall

## Envelope

The enclosure system was designed to achieve high levels of thermal performance and minimize heat loss through an insulated, carefully detailed assembly. The wall system consists of a double-stud configuration using two parallel **2x4 walls**, with a target wall performance of approximately R-40.

The roof assembly was designed to achieve a target insulation level of approximately R-60, supporting reduced heat loss and overall building efficiency. The foundation system incorporates **rigid board insulation**, including polyisocyanurate, with spray foam used sparingly and only at critical transition points such as rim joists and window interfaces.

Window performance was carefully tailored based on orientation to balance heat retention and solar gain. North-facing windows were specified with **low-emissivity coatings** positioned to retain interior heat, while south-facing glazing was configured to allow solar heat gain during winter months. Window performance ranged from approximately U-0.25 for the largest window to approximately U-0.15.



*Naomi Darling Architecture, Randall Design Process*

Additional passive design strategies include the incorporation of operable windows in each room to support natural ventilation and the use of ample daylighting for occupant well-being as well as to reduce reliance on artificial lighting.

## Mechanical Systems

The Park Hill Residence and Studio operates as a **fully electrified building** with **no on-site combustion systems**. A **ducted air-source heat pump** provides heating and cooling, sized to meet the reduced loads made possible by the high-performance enclosure. An **energy recovery ventilator** delivers balanced ventilation, maintaining consistent indoor air quality while minimizing energy losses associated with fresh air exchange. A **heat pump water heater** supplies domestic hot water.

## Solar and EV Infrastructure

The building form and layout were carefully developed to **maximize solar gain**, daylight access, and **occupant comfort** while **minimizing energy demand**. The roof geometry was specifically shaped to align with the solar angle at the project's latitude, resulting in an asymmetrical roof form optimized for photovoltaic panel performance. Exterior shading devices, including fixed louvers, were integrated to reduce unwanted summer heat gain while still allowing beneficial winter sun to penetrate the interior.

The project includes an **on-site photovoltaic** system that was integrated into the building design from the outset. The roof geometry and orientation were optimized to maximize solar exposure and energy generation potential. The project also includes one installed **electric vehicle charger**.

## Performance Results

Assembly/System	Material	Metric	Value	Notes
<b>HERS Rating</b>	N/A	HERS ERI	40 (with PV) / 40 (without PV)	Massachusetts Stretch Code target for single-family homes typically ranges from HERS 52–58 depending on pathway and renewables. The project team indicated that the final HERS score is likely to be lower once testing and verification are complete.
<b>Walls</b>	Above-grade wall assembly	R-value	R-37	Approx. 10" double-stud wall assembly. Dense pack cellulose insulation
<b>Slab</b>	Insulated slab	R-value	R-8	Under slab R-8; perimeter R-8
<b>Roof</b>	Vaulted roof	R-value	R-56	
<b>Windows</b>	High-performance glazing	U-value / SHGC	0.15-.25 / 0.32	Performance varies by size and orientation
<b>Heating</b>	Air-source heat pump	HSPF	11	Mitsubishi
<b>Cooling</b>	Air-source heat pump	SEER	22-29.80	Mitsubishi
<b>Water Heating</b>	Electric water heater	COP	3.75-4.07	RHEEM hybrid electric heat pump
<b>Ventilation</b>	Energy Recovery Ventilator	Airflow / Power	60 CFM / 28 W	Balanced ventilation

### Cost and Funding Insights

Detailed project cost information was not disclosed at the request of the homeowner. However, the owner characterized the project as a **long-term investment in health, durability, and overall quality of life**. The decision to pursue high-performance design was informed by an understanding that higher upfront costs can result in reduced operational expenses and fewer long-term maintenance needs.

The project team also identified several cost drivers. The construction process was influenced by a range of site-specific and regulatory challenges that affected both timeline and cost. The steep topography required careful grading and driveway design to meet access requirements, including maintaining a slope of ten percent or less to avoid triggering additional fire protection requirements.



### Cost and Funding Insights (cont.)

Environmental considerations also played a significant role, as the presence of wetlands near the site required coordination with the local Conservation Commission. This resulted in an extended permitting process that involved multiple rounds of review and adjustments, particularly related to driveway placement. Additional regulatory constraints related to shared driveway access further complicated site planning. These permitting challenges, combined with winter construction conditions, contributed to project delays and increased construction costs.

**The project team also pursued Mass Save all-electric home incentives of approximately \$15,000 for single-family homes meeting high-performance criteria, including a HERS Index score of 45 or lower.**

## Outcomes & Lessons Learned

The project demonstrates the importance of integrating passive design strategies at the earliest stages of development, as decisions related to site orientation, massing, and solar access had a significant impact on overall performance. The use of **midpoint blower door** testing proved critical in identifying and addressing air leakage issues before the enclosure was finished with interior finishes. This iterative testing process, conducted in coordination with Powerhouse Energy Consulting, allowed the project team to correct deficiencies and improve airtightness outcomes.

The project also highlights the impact of site and regulatory constraints on project delivery, demonstrating that permitting processes and environmental considerations can significantly influence both cost and schedule.

Finally, the project underscores the role of long-term ownership in shaping investment decisions, as the homeowner prioritized durability, energy efficiency, and indoor environmental quality over short-term cost minimization.

*Special thanks to the insights provided from Karen Randall, (homeowner), Naomi Darling, founding principal of Ko-LAB Architecture and Five College Associate Professor of Sustainable Architecture, and Seth Lawrence-Slavas, Wright Builders President.*

*To view additional Massachusetts case studies, visit the link below:*

<https://neep.org/code-collaboratives/massachusetts-case-studies>