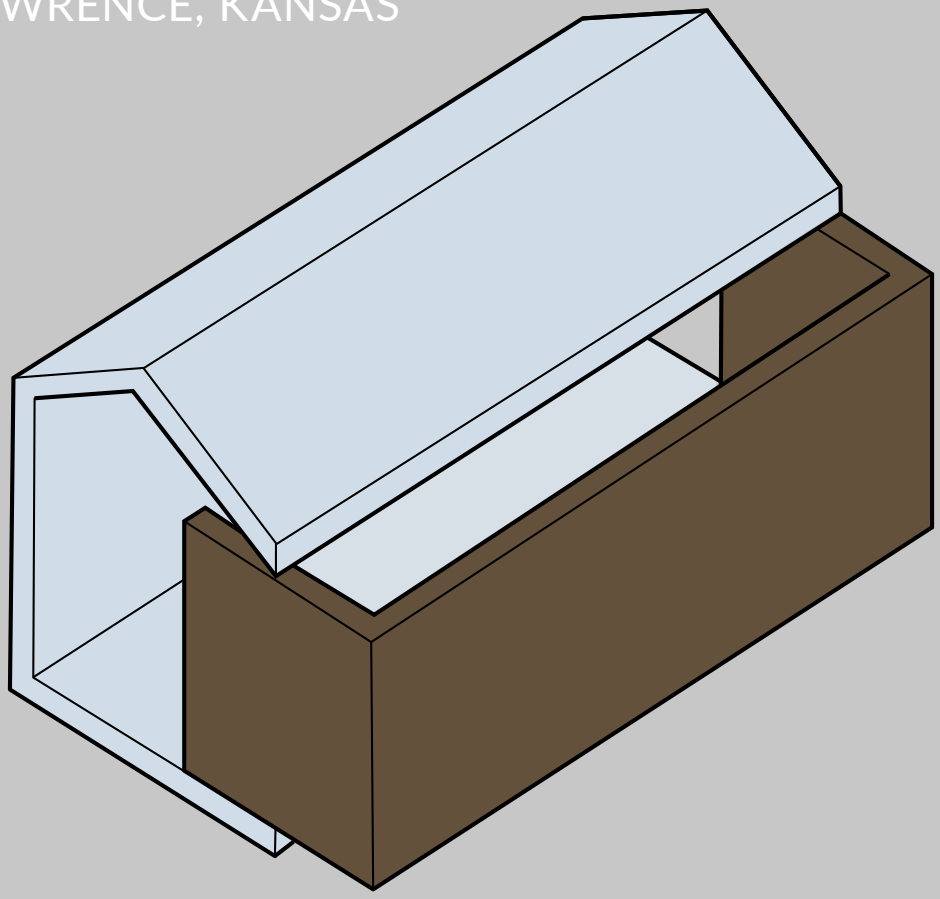
KU SCHOOL OF ARCHITECTURE & DESIGN
The University of Kansas

DURABILITY & RESILIENCE
JURY DOCUMENTATION

Dirt Works Studio

HAVEN STUDIO

LAWRENCE, KANSAS



DURABILITY & RESILIENCE

Haven Studio, rendering of the southeast corner showing the main entrance

Durability

This project focuses on local, low-maintenance materials that function in the variable Midwestern climate. Focusing on durability will make the home wear slower than a typical home. The design philosophy was to create a smart design, but a simple home that does not utilize many moving parts that would require substantial upkeep. The fully tiled bathroom is a durable surface that will withstand wear and tear as well as be easy to clean. The whole north wall is made of cabinetry or clad with Richlite, and two-thirds of the south wall is glass, so there is very little exposed drywall that would need to eventually be repainted. The mechanical systems will be controlled from a single panel that connects to both the ERV and the air handler to easily adjust for occupant comfort. The MEP equipment in the loft is all easily accessible through the access panel, where each piece of equipment is within an arm's reach. The occupant and daylight sensors will keep the LED lights functional for an exceptionally long time, as they will only be on when needed.

On the exterior, the thermally modified ash rainscreen will protect the moisture barrier from wear and tear from the weather and the horizontal orientation of the cladding will provide additional shear strength. The thermal modification protects the wood without chemicals, prevents pests, and will not need to be refinished over time. The project's structure uses Build SMART's prefabricated E-walls, which provide exceptionally high-strength walls, especially for a home of this size. Concentrating the openings to one location minimizes the penetrations in the envelope, reducing the risk for air leakage and thermal transfer.

Standing seam metal roofing was chosen as it is durable and long lasting. Although it has a higher embodied energy, the years that it will last will offset that embodied energy as it does not need to be replaced as frequently as other common roofing materials. The roof folds down to cover the north wall, which protects the most exposed side of the house. Instead of a traditional gutter on this side, the drainage system in the ground moves the water away from the house and into the underground drainage drywell. The lack of above ground guttering on this side prevents issues from a backed-up gutter. The plumbing is organized to only have a single vent stack, allowing the roof to only have one penetration and reduce chances for leaks. The landscaping will utilize low-maintenance natives that will not require as much water or upkeep as a typical lawn.

The foundation consists of twenty-one piers which raise

the house above ground level. This prevents issues from foundations leaking, protects the house from flooding, and improves access to utilities for maintenance. The concrete pier foundation reaches four feet below grade to below the frost line. This system allows the structure to be moved in the future, if necessary.

Performance

The house will be able to provide occupants critical load capabilities and recover from potential natural disasters. The house's critical load capabilities are enhanced by how small it is. The resources required to operate the house are far fewer than that of a typical home. Even in a typical grid outage and suboptimal solar conditions, the oversized solar system will generate sufficient power to maintain critical life-safety functions. Additionally, the well-sealed and highly insulated envelope will maintain internal conditions without constant power.

The house itself is lifted off the ground by the piers to protect from flooding. Even if flooding were to reach the house, the main mechanical equipment that would be the most challenging to replace if damaged is in the loft over the bathroom. The condenser unit is elevated and attached to the north wall so that snow will not negatively impact the performance of the heat pump.

The structure was intentionally designed with redundancy in mind. The house sits on twenty-one concrete piers, every other stud is doubled up to add extra strength, and the ridge beam is made of three layers of LVL. This robust and more conservative approach to engineering will allow the building to survive high winds and stand the test of time.

Resource Management

While the home does not actively collect water for internal use, it successfully manages all stormwater to keep all water on site. The south roof collects its water through a gutter system to two rain chains, articulating the movement of the water from the roof to the ground. The rain chains take the water to the perimeter drainage of the house which feeds into a dry well. The north roof folding over the wall lets the water wash straight over the envelope down into the perimeter drain. The rest of the site is sloped down to the northwest corner where the drywell is located and functions as a bioswale. The site is landscaped with native grasses and low-maintenance plants that will use the stormwater as their primary water source. The landscape design creates an outdoor collaboration space with privacy elements to shield from the surrounding parking lot, creating a teaching space to learn about stormwater management in a place that is successfully integrating strategies.

The twelve solar panels on the roof of Haven Studio are

Haven Studio, photo of installing the ridge beam onto the Build SMART prefabricated wall panels.

Haven Studio, view of the interior wall framing showing the doubled studs.

estimated to generate more than enough electricity for the project. This project, as an accessory structure to the existing KU Designbuild Center, is tied to the same energy grid. Instead of storing the extra power, it will be used to offset the energy used within the KU Designbuild Center. This is essentially the same as net-metering, where excess energy is sold to an energy company and then bought back as needed and could be implemented like this in a future project. Should energy ever needed to be drawn from the grid, 44% of the energy produced in Kansas comes from renewables. The home's energy load will be reduced by thought¬ful passive strategies and active systems and offset by a robust solar energy collection system.

Similar to the electrical system, the plumbing system is tied into the existing KU Designbuild Center. Linking both systems to the existing building saved resources associated with establishing new connections to the grid and municipal systems.

Passive strategies, like highly insulated and air-tight homes have been proven to help reduce energy bills. The quad-pane window wall concentrates all the glazing of the home into one area that can be protected from unwanted heat gain in the summer by a roof overhang but optimized for beneficial heat gain in the winter. The overall percentage of glazing in the home compared to surface area is low, which minimizes overall energy loss through the glazing. The large glazing provides sufficient natural light to the home for 47% sDa, reducing the energy needed for artificial lighting. The prefabricated wall panels from Build SMART have been constructed in a factory to make them more precise than if built on-site, allowing them to fit together tighter, and they are sealed with a liquid flashing product from Prosoco that fills in any gaps. The continuous rigid timber insulation in combination with the cellulose batt insulation creates a home with double the insulative performance of a typical home. The systems have been optimized to penetrate the envelope as little as possible to reduce the chances of air leakage. The selection of durable materials reduces lifecycle impacts.

Resilience

The house is prepared to maintain critical operations during disruptions and quickly restore normal operations. Since the house overproduces in a normal situation, the house can still meet its needs in a suboptimal solar condition. The house can maintain a comfortable temperature through passive heating and insulation, and daylight comfortably lights the space, so the house would need minimal energy to keep just the fridge and HVAC running as critical equipment. With a "smart design, simple home" concept, there is little else that requires power for the house to function properly, meaning that the house can easily restore normal operations.

Innovation

The project is innovative in its approach to occupant health. Many traditional materials are made with chemicals that off-gas harmful VOCs. This project focuses on local, low-maintenance, and primarily bio-based materials that function in the variable Midwestern climate and reduce embodied carbon. Low and non-toxic materials have been selected to ensure good indoor air quality, which is particularly important in a home that will have relatively few air changes per hour. Wood is emphasized throughout the project from the exterior rainscreen, to the floors, ceiling, and cabinets on the interior, to the framing and insulation in the envelope. Since wood is a bio-based material, it is free from the toxic chemicals found in synthetic materials, creating a home that is healthy for its occupants.

Haven Studio, photo of the piers and pier connectors that hold the floor structure off the ground..

Haven Studio, photo of thermally modified ash rainscreen material.