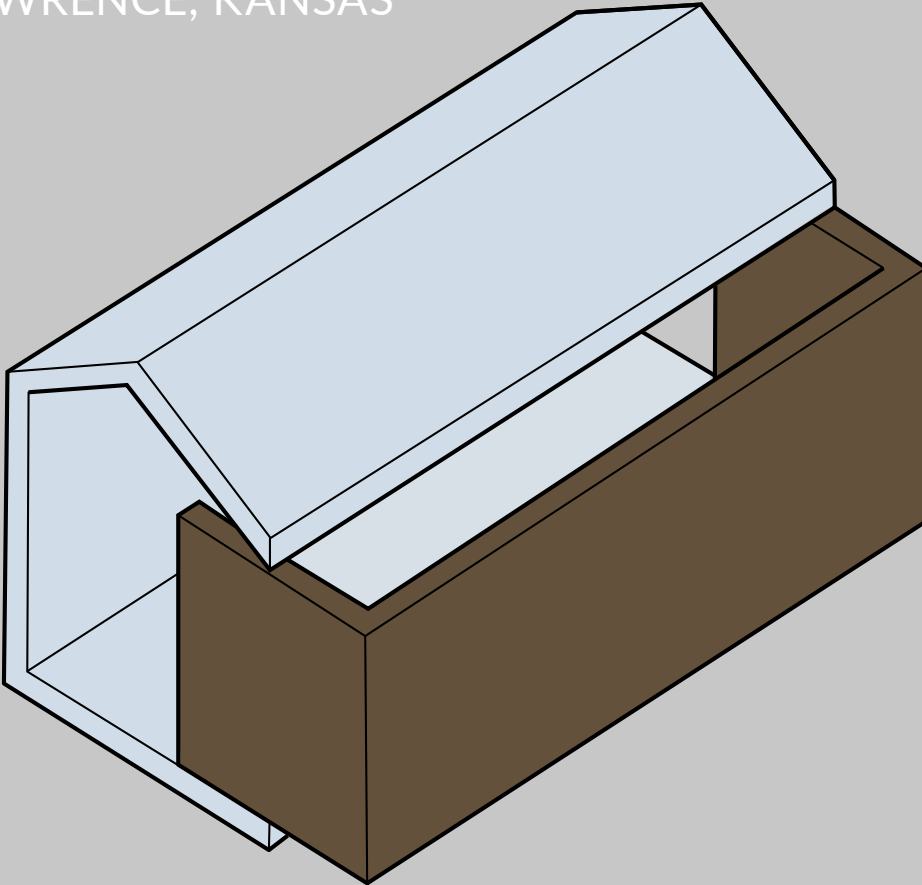


Dirt Works Studio

H  HAVEN  
STUDIO

LAWRENCE, KANSAS



# ARCHITECTURE



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

## Architectural Concept

The University of Kansas' Dirt Works Studio has created Haven - a series of designs that implement best practices for the design and construction of sustainable, net-zero energy homes, drawn from the regional vernacular of the American Midwest. The version of the project built for the 2023 Solar Decathlon Build Challenge, Haven Studio, is a studio-sized version of the concept that can also be expanded to one- and two-bedroom variations, demonstrating that these design principles can be applied at multiple scales. The initial project will serve as a prototype; and since it is built adjacent to the KU Designbuild Center, it will serve as a living classroom for generations of architecture students, community partners, and the broader community for years to come.

Haven Studio's concept design draws from the historic fabric of local neighborhoods and archetypal ideas of home and refuge. The simple rectilinear form and modest footprint suggests propriety and careful stewardship of limited resources. The east and west facades, with their simple gable forms, are relatable while demonstrating sustainable practices; the south roof pitch is positioned to optimize the angle of the solar panels. A durable metal clad roof wraps down over the north façade, providing protection from the mercurial

Midwestern climate and its extremes, while the wood rainscreen that encloses the rest of the home gives way to a large window wall on the south, protected from overheating with deep roof eaves while offering views of the landscape and ample natural light. An emphasis on wood across all layers of the building envelope and throughout the interior prioritizes natural, renewable materials over synthetic or non-renewable materials, while creating an atmosphere of warmth, further reinforcing the concept of home and community.

## Community Context

Haven Studio, as a permanent living laboratory and demonstration home, has been built on University of Kansas property, in a non-residential setting. This unique condition affords this project several important opportunities, including expanding learning opportunities beyond the multi-semester team of architecture students who designed and built the project to include generations of architecture students to come; extending the public exhibit beyond the limited period mandated by the Solar Decathlon competition to showcase the home indefinitely; and providing a proof-of-concept sustainable home for our local community. This project has

already become a catalyst for a new partnership to design and build several homes over the next few years with Tenants to Homeowners, a local organization that provides affordable housing for our local community. These houses will support the most difficult members of our community to house; the gable form creates a familiar image of home to help ease the stresses and disorientation often associated with homelessness.

The commercially zoned setting for Haven Studio required that the project follow the International Building Code, rather than the International Residential Code. These more stringent requirements include universal design strategies and more robust engineering, modifications that ultimately may be beneficial in the context of supportive housing.

Some of the design features of the home, however, anticipate more residential settings, such as the large south-facing window wall which would ideally face toward a private side yard (but in this context faces an intimate courtyard created by placing the demonstration home near the existing KU Designbuild Center).

### Use and Experience

The word studio in Haven Studio is intended as a double entendre - to express a dual meaning. First, it refers to the studio style of organizing a living space, without walls

separating discrete areas of the home. Haven Studio's only enclosed space is its bathroom and upper mechanical loft. The rest of the space is open and contiguous, comprised of a kitchen and dining area near the front of the home and a living and bedroom area towards the middle of the home. This middle area includes a sleeper sofa that is used throughout the day to accommodate the typical functions of a living room and by night converts into a bedroom. This flexibility of use creates efficiency and economy. However, as a demonstration home, this project will also serve a different function as a classroom space. In this context, studio alludes to its purpose as an accessory structure to the KU Designbuild Center. In this capacity, the space will serve as a clean, quiet, and temperature-controlled space for designbuild studios to gather, to discuss and plan, to meet with potential community partners, and to display sustainable design. To accomplish this change of use, the dining table can be exchanged for a longer conference table that stretches the length of the space. Haven Studio's open floor plan is adaptable and can provide for a variety of needs at the KU Designbuild Center.

Upon entering the home, the main living space opens to the gable, making the relatively small room feel significantly bigger. Immediately to the left, the quad pane window wall looks out over natural vegetation, experientially extending the room into the garden. These simple moves provide an opportunity to reflect natural light throughout the space. The living space begins in the kitchen. The whole north wall is comprised of an integrated cabinetry system faced with



Haven Studio, photo of the south facade showing the large glass wall.



Haven Studio, photo of the south and east facades.

reclaimed Baltic birch plywood, with custom cabinets made for the appliances. The wood floors work with the wooden cabinetry wall to add warmth to the space while keeping it light and bright. The countertops and backsplash made of black Richlite, a compressed paper product, bring a richness and depth into the space and contrast with the lightness that dominates the room. Continuing west into the space, the cabinetry wall extends into the living room. Upper cabinets above the sofa terminate with the custom wardrobe cabinet to provide personal storage. The lack of sharp divisions between the kitchen and living room creates a space that can accommodate a range of functions. At the house's western end, the ceiling lowers over the hallway and bathroom to create a more relatable scale and provide adequate space for the house's mechanical organs. Signage from the public exhibit will be made permanent to explain the systems to future generations of students. The light maple ceiling across this whole space adds additional warmth. The bathroom is tiled with a contrasting dark floor which will hide dirt and the white subway tile from floor to ceiling bounces the light around the room. Richlite is used again for the vanity countertop and the ceiling above the shower. Inside the bathroom, a linen closet provides additional storage. The hallway ends with the stacked washer/dryer closet, then spills out onto a deck to provide connected indoor/outdoor space.

### Materiality

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 were selected to ensure good indoor air quality, which is particularly important in a home that will have relatively few air changes per hour. The material palette was kept quite simple and intentional, as too many conflicting material choices would perceptually shrink the already small space.

On the exterior of the home, the walls are clad in a horizontal, thermally treated ash wood rainscreen that wraps the east, south and west walls and creates a warm and inviting façade that connects to the natural environment. The standing seam metal roof is not only a durable and low maintenance choice, but the light color reflects heat, which reduces cooling loads on the house. Architecturally, the roof folds down and covers the north wall, tying them together. The north is the most vulnerable side of the project, with harsh winter winds predominantly coming from this direction. The solid, sturdy material wraps over the house and shelters the warm, wood interior. The contrasting metal and wood create a feeling of safety and security for the occupants. Light painted cement board is another durable choice that covers surfaces less likely to be impacted by weather. The natural vegetation surrounding the house acts as the fourth major material on the exterior, as the large quad-pane window creates a strong visual connection from the inside to the outside.

On the interior, wood is the primary material. Both the floor and dropped ceiling are maple, with the ceiling being reused from leftover material from a past project. The Baltic birch cabinet wall in the main living area is the primary design feature of the interior space. To maintain a clean look and prevent clutter, pulls for the cabinets have been integrated into the doors themselves. The edge was mitered to create space for fingers to slip behind the door, but then rounded off to create an ergonomic and welcoming touch. All of the Baltic birch plywood for the cabinetry wall was reclaimed, reducing waste and expense, while avoiding any entanglement with the Russian-Ukrainian conflict, while still obtaining the desired effect. The right size piece was not always available, so several pieces were joined together to create larger panels for the custom wardrobe and refrigerator cabinets. Along these seams, a 1/8" reveal has been cut to express the origin of the wood and demonstrate the beauty of reclaimed materials.

The wood throughout the project adds warmth and ties the spaces together. To contrast the wood, most large surfaces are white, which has the added benefit of reflecting light throughout the rooms. Special elements, like the countertops, backsplashes, and thresholds are black Richlite, a product made of recycled compressed paper. The three main colors found throughout the design keep a simple and calming color palette that ties all the spaces together.

### **Passive Strategies**

The Kansas climate is characterized by constant and dramatic change; from hot, humid summers to cold, dry winters, and everything in between. Select passive strategies have been adopted as a basic approach to address this mercurial climate, specifically a highly insulated and airtight building envelope. The Dirt Works Studio team partnered with Build SMART, a local company that prefabricates highly insulated, airtight wall and foundation insulation systems. The construction of the wall assembly combines a variation on traditional light-frame wood construction with structural-insulated panels (SIPs), integrated windows and doors, and their sister-company Prosoco's high-performance liquid-applied flashing. The prefabricated panel's precision creates an airtight fit and reduces on-site construction time. These panels can provide an R-50+, far exceeding the code-required minimum. As an added benefit, Build Smart's headquarters is a few hundred yards from the site of this demonstration home, expanding future visitors to incorporate Build Smart's potential clients.

The home's narrow footprint is easy to naturally light, significantly reducing the need for artificial lighting during the day. The roof slope was carefully chosen for the optimal angle for fixed solar panels on the south-facing portion of the gabled roof. The protective and well-insulated north facade is free of openings that might contribute to energy loss during the substantial number of heating degree days, while the south facade is characterized by large, glazed surfaces, protected by overhangs, to take advantage of passive solar heating while avoiding overheating in the summer.

### **Lighting Strategy**

The large, quad-pane window wall and glazing integrated into the exterior doors provides ample daylighting of the main living space throughout the day. All the light fixtures are low energy LED and can be dimmed, which improves occupant comfort by adjusting the light level to be appropriate to the task. The daylight sensor integrates with the dimmable fixtures and adjusts these levels according to the amount of available daylight. Three occupancy sensors in the project allow users to not have to think about turning the lights on or off as they move through the home, saving energy as the lights will turn

off when spaces are not being used. The daylight and occupancy sensors will work together to provide appropriate artificial light to address user needs.

### **Innovation**

This project balances innovation with adoptability and prioritizes creating design solutions that can be implemented in near future projects by the public. The large window wall utilizes quad pane technology, sandwiching layers of argon and ultra-thin glass to create a highly energy efficient glazing unit that provides even better performance than triple-pane glass windows which are already considered very efficient. The window wall concentrates all the glazing of the home into one area that is protected from unwanted heat gain by a roof overhang sized to allow 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 placement of the glass is also innovative in how it expands the sense of space and volume in an otherwise modest home and creates a visual connection to low maintenance vegetation. The home is right sized without feeling claustrophobic, keeping energy loads low. The glazing provides adequate daylighting to keep the space feeling bright and open.

The efficiency of a studio layout applied to the concept of a house allows four different uses to combine into a single space. Everything in the house must do more than one thing, so rather than create redundant spaces, Haven Studio takes advantage of several spatial overlaps. This translates into energy efficiency by reducing the volume that needs to be conditioned. The dining table is designed to be the same height as the kitchen counter, allowing it to not only serve as a dining table, but also serve as an extension of the kitchen during food preparations and transform into a workspace outside of mealtimes. The sleeper sofa transforms during the day from a bedroom to a living space with ample floor space to make the room feel larger.

The project has great promise in demonstrating the capacity for sustainable design at multiple scales, and in the lives of the students who will have contributed throughout the process, who will in turn be the future leaders of a more sustainable world.



Haven Studio, photo of interior showing the main studio space looking west



Haven Studio, photo of kitchen cabinet wall.



Haven Studio, photo of interior showing the main studio space looking east



Haven Studio, photo of interior showing the hallway



Haven Studio, photo of interior showing the bathroom



Haven Studio, photo of interior showing the living room cabinet wall



Haven Studio, photo of interior showing the mechanical loft.



Haven Studio, photo of exterior showing the south and west facades.