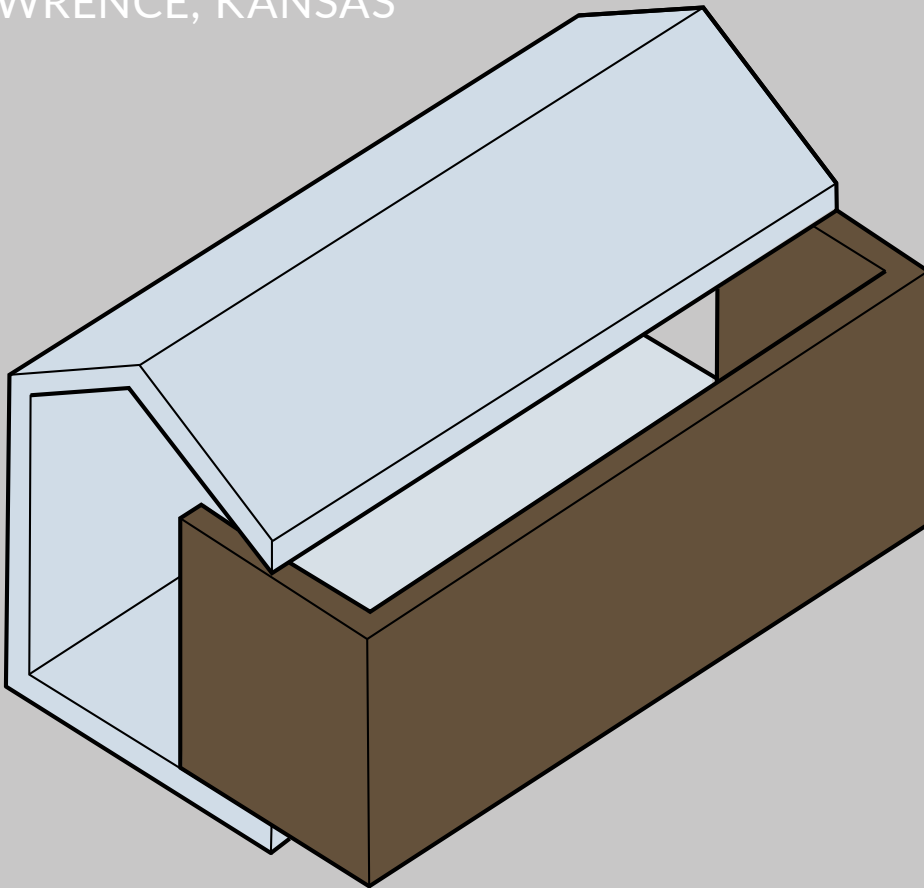


Dirt Works Studio

H  VEN
STUDIO

LAWRENCE, KANSAS





DIRT WORKS STUDIO

Dirt Works Studio is an award-winning, designbuild studio in the School of Architecture and Design at the University of Kansas taught by Associate Professor Chad Kraus. This studio aims to cultivate sensitivity to natural and cultural forces specific to the conditions of each project through the use of earth-originating materials and a focus on human experience. Starting in late-October 2021, four cohorts of Dirt Works Studio students across four academic semesters worked tirelessly on the Solar Decathlon Build Challenge 2023 project Haven / Haven Studio. In many cases, students from earlier cohorts continued on with the project through special elective courses with Professor Kraus. Ultimately, Haven Studio will be an interactive, full-scale, teaching tool and learning environment to benefit current and future generations of students as well as our broader community.

Copyright © 2023 Dirt Works Studio.

All rights reserved. This book or parts thereof may not be reproduced in any form, stored in any retrieval system, or transmitted in any form by any means – electronic, mechanical, photocopy, recording, or otherwise – without prior written permission of the publisher, except as provided by United States of America copyright law.

www.dirtworksstudio.ku.edu

All drawing, renderings, and photographs © Dirt Works Studio unless otherwise noted.



Dirt Works Studio_Fall 2021

Left to right, back row: Chad Kraus (Faculty Lead), Andrew Jundt, James Noteman, Andrew Stender, Liz Fraka, Tylor Poitier, Lauren Maloney, Graylon Sestak, Brenna Richart, Nicholas Einig, KayLee Nottestad, Cooper Plaster, Harleigh Brandon; *front row:* Bridget Gerstner, Gwendolyn Comas, Emily Almloff, Claudia Frahm, Kodi Hayes, Erica Villamayor



Dirt Works Studio_Spring 2022

Left to right, sixth row: Andrew Jundt, Andrew Stender, Tylor Poitier, Arianna McCue, Jackson Bontty, Alec Hendrix, Ehren Coleman, Chad Kraus (Faculty Lead); *fifth row:* Lauren Maloney, Madison Smith, Sarah Boyle, Garrett Miller, Sarah Moore; *fourth row:* Harleigh Brandon, Madison Schaefer, Brenna Richart, Elizabeth Stone; *third row:* Emily Almloff, Erica Villamayor, Jenna Bracaglia, Cora Blackford, Liz Fraka; *second row:* Eryn Herrera, Gwendolyn Comas, Claudia Frahm, Lily Altenhofen; *first row:* Bridget Gerstner, Maddie Parr, Maddi Beck, Abi Price



Dirt Works Studio_Fall 2022

Left to right, back row: Chad Kraus (Faculty Lead), Andrew Jundt, Tylor Poitier, Michael Akanni, Reece Mehrens, Matteo Kalusha-Aguirre, Crayton Maurer, Brennen Berends, Lauren Maloney, Caleb Tatley; *middle row:* Andrew Stender, Lexie Wolff, Areli Madrigal, Erica Villamayor, Harleigh Brandon, Erin McMahon, Carson Severt, Kaitlyn Dunn, Micah Ramsay; *front row:* Liz Fraka, Yuridia Alviter-Rivera, Claudia Frahm, Bridget Gerstner, Abi Price, Fernando Echauri, Haleigh Strebe, Aria Lynch, Jay Clements



Dirt Works Studio_Spring 2023

Left to right, back row: Jake Hornbuckle, Luke Delehaunty, Andrew Stender, Andrew Jundt, Tylor Poitier, Reece Mehrens, Crayton Maurer, Tom Schotte, Caleb Tatley, Anas Alghamdi; *middle row:* Micah Ramsay, Brennen Berends, Grant Miller, Erin McMahon, Harleigh Brandon, Emma Herr, Kyle Kissel, Ty Adams, Kiara Smallwood, Chad Kraus (Faculty Lead); *first row:* Liz Fraka, Claudia Frahm, Abi Price, Bridget Gerstner, Anan Hoque, Erica Villamayor; *not pictured:* Lauren Maloney, Brad Elpers



PUBLIC PROJECT SUMMARY



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

PROJECT INTRODUCTION

Dirt Works Studio designed Haven, a two-bedroom net-zero energy home, in Fall 2021 and Spring 2022. Due to extenuating circumstances, this project had to quickly pivot to a new community partner, a new site, a condensed scope, and a new funding strategy; the redesigned project is called Haven Studio. The design of Haven Studio retains much of the original design, demonstrating how its design principles are scalable and versatile. **Haven Studio will be an interactive, full-scale, teaching tool and learning environment to benefit current and future generations of architecture and design students at the University of Kansas as well as our broader community.**

DESIGN PHILOSOPHY AND OBJECTIVES

Dirt Works Studio has created a multifaceted project – Haven Studio – that will demonstrate best practices for the design and construction of sustainable, net-zero energy homes for future architecture and design students, community partners, and the broader community. Since it has been built adjacent to our KU Designbuild Center, it will demonstrate these values as a teaching tool and living lab for years to come. In addition to serving as a demonstration net-zero energy

home, Haven Studio will function as a clean and quiet space for design collaboration and meetings with outside partners or clients engaged in collaborations with KU Designbuild. The living room cabinetry wall will also serve as a materials library, and the main studio space will be outfitted with flexible furnishings to allow the space to easily shift between a residential mode (dining table and sleeper sofa) to a classroom mode (conference table and bench). Finally, the exterior street-facing north façade of the house will serve as a surface to mount signage to, which will finally and appropriately identify East Hills as the home of KU Designbuild.

The basic design concept draws from the historic fabric of local neighborhoods as well as archetypal ideas of home. The east and west facades, with their simple gable forms, are relatable while demonstrating sustainable practices. An emphasis on wood creates an atmosphere of warmth, further reinforcing the concept of home and community.

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. To achieve this, Dirt Works Studio partnered with Build

SMART, a local company that prefabricates highly insulated, airtight wall systems. The construction of the wall assembly combines a traditional light-frame wood construction with continuously insulated layers, integrated windows and doors, and liquid-applied flashing. The prefabricated panel's precision reduces air infiltration and reduces on-site construction time. These panels can provide an R-50+ thermal envelop, 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.

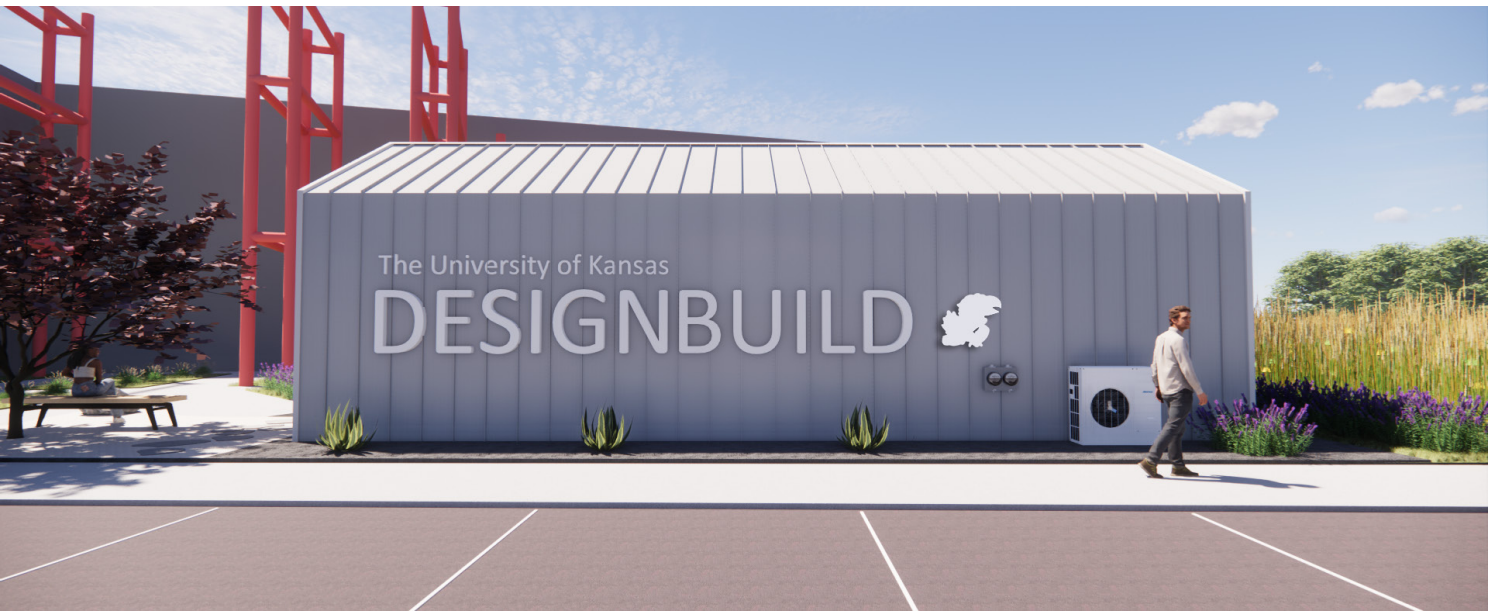
The home's narrow footprint is relatively easy to naturally light, reducing artificial lighting use during the day. The roof slope was chosen for its optimal angle for fixed solar panels on its south-facing side. The well-insulated north facade is free of openings that might contribute to energy loss during the large number of heating degree days, while the south facade is characterized by a large, quad-pane glazed surface, protected by an overhang, to take advantage of passive solar heating while avoiding overheating in the summer. This project focuses on low-maintenance and primarily bio-based materials that function well in its climate while reducing embodied carbon. Low and no VOC materials were selected to ensure good indoor air quality, which is important in a home with relatively few air changes per hour. The exterior walls are clad in thermally-treated ash rainscreen while standing seam metal panels cover the roof and north wall to protect the home at its most vulnerable surfaces.

While the intention is for this home to be net positive, it will be connected to the electrical grid. Even when drawing electricity from the grid, 44% of the energy produced in Kansas comes from renewables (EIA.gov). The home's energy load will be reduced by thoughtful passive strategies and carefully selected active systems and offset by a robust solar energy collection system. Energy-efficient home appliances will not only function well but will also contribute to lower utility bills. A heat pump mini-split system will control temperatures throughout the home, while an energy recovery ventilation (ERV) system with an integrated HEPA filter will help to efficiently draw in fresh air while reducing energy loss by pre-conditioning supply air with heat and humidity extracted from exhaust air. The highly insulated walls will also protect from infiltration of exterior noise. Passive and active strategies can significantly reduce energy loads, thereby minimizing the size and cost of energy generation systems to ensure a net-zero energy home. The strategies implemented will help the home to achieve a low HERS rating score, provide for occupant comfort, and lower the home's carbon footprint.

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, rendering of the south facade showing the large glass wall and wood rainscreen



Haven Studio, rendering of the north facade showing signage

CONSTRUCTION SITE

Haven Studio is built as an accessory structure adjacent to the University of Kansas' Designbuild Center, five miles east of the main campus. Due to this being university property, the State of Kansas served as the local Authority Having Jurisdiction rather than the City of Lawrence. In addition, because the demonstration home is located in a non-residentially-zoned area, the project was designed and built to the International Building Code as a commercial project.

The home is sited in a small plot of land tucked between existing sidewalks, with an existing parking lot to the north and the existing Designbuild Center to the south. The project was placed as close to the parking area and north sidewalk as possible in order to provide enough physical separation from the existing building to maximize solar energy access. By placing the project in this location, the space between the two buildings will serve as a vegetated courtyard, protected from the street, parking, and winter winds, for students to spend time outside between classes.

The Designbuild Center has an excess of parking spaces, so parking at the new project is not an issue. All project utilities were tied into existing infrastructure already on site, including domestic water and sewer lines. Electrical and telecommunication services were tied directly into the existing building's services. This situation posed both opportunities and challenges, such as not having to set up new service accounts but having to run extensive conduit through the existing building and through underground trenches across existing infrastructure. Due to the low anticipated energy loads of Haven Studio, the 12-panel solar array will easily offset energy loads. All excess solar production, instead of being returned to the grid, will go back to the main building to offset a portion of its energy use, thereby reducing grid energy use even further.



Haven Studio, aerial photograph of the construction site



Haven Studio, construction photograph

CONSTRUCTION PARTNERS

During the design phase, Dirt Works Studio partnered with BNIM (architectural consulting), Apex Engineers (structural engineering), Henderson Engineers (MEP engineering), SunSmart Technologies (solar system design), and Mercer Zimmerman (lighting consultant). These professional partners provided valuable expertise and feedback to the team.

During the construction of Haven Studio, Dirt Works Studio worked with a wide array of industry partners and suppliers. Early in the construction process, Mar Lan Construction assisted the team with foundation excavations and utility trenching. Grabill Plumbing provided essential plumbing services and guided students through the work as did Westerhouse HVAC for mechanical services. Lynn Electric provided a highly skilled electrician to work with students throughout each phase of the electrical installation and performed key portions of the work. Build Smart prefabricated wall assemblies and provided consultation on their installation. Kennedy Glass provided consultation on glazing the window wall system. In addition to these construction partners, there are many industry partners that provided discounted or donated materials or products, and several provided guidance or advice to the team. We would like to acknowledge their collective generosity here:

Industry Sponsors

Alpen HPP [window wall]
 AZZ Galvanizing [galvanizing]
 Bauco [access panel]
 Beko [appliances]
 Brownlee Lighting [lighting]
 CMS [cellulose insulation]
 Cooper Lighting [lighting]
 Daltile [tile]
 Deer Valley [plumbing fixtures]
 Emerson [plumbing fixtures]
 Green Tech Renewables [EV charger]
 Hunter Douglas [roller shades]
 KC Millwork / TruStile [interior doors]
 Kelvix Lighting [lighting]
 Kohler [plumbing fixtures]
 Lumber One [lumber]
 MBCI [metal roofing]
 Midwest Concrete Materials [concrete]
 Mitsubishi Electric [HVAC system]
 Prosoco [liquid-applied flashing]
 REW Materials [drywall]
 Richlite [countertops]
 Rothoblaas [specialty hardware]
 Royal Metal Industries [steel]
 Schluter Systems [tile system]
 Shaw Floors [tile]
 Simple Human [accessories]
 Simpson Strong-Tie [timber connectors]

Spectrum Paint [paint]
 Sonoco [sonotubes]
 Tech Lighting [lighting]
 Teron Lighting [lighting]
 TimberHP / Steico [timber insulation]
 Wood Haven [wood rainscreen]

Project Sponsors

BRR
 Clark Huesemann
 Grabill Plumbing
 HOK
 Hoke Ley
 Hollis + Miller
 Hufft
 JE Dunn
 KTG
 M&W Enterprises
 Odimo
 Sabatini Architects
 Slaggie Architects
 Treanor HL
 KU School of Architecture and Design
 KU Student Senate
 Weiland Family / Steel Erectors and Machinery Movers Association



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

PUBLIC EXHIBIT

Ultimately, Haven Studio is both a *demonstration house* and a *living laboratory*. As a demonstration house, the project will demonstrate beneficial features and characteristics of a net-zero energy house in the American Midwest. During the Solar Decathlon public exhibition, the team will place signage to better explain these systems and features. However, Haven Studio will not go on to become a conventional house. Instead, after the public exhibition and once the competition draws to a close, Haven Studio will continue to be used as a demonstration home in perpetuity. This means that our approach to signage and the public exhibition will tend toward a more permanent communication strategy.

For this reason, the team has elected to place the heat pump mini split condenser adjacent to the main sidewalk and parking area, with accompanying signage. We also have placed the solar system disconnect and meter right where they can be seen by all. The solar panels themselves will be clipped onto the standing seams and easily see from the ground on the south side. In addition to overall building signage, we intend to install on the exterior wall permanent diagrams explaining these systems and how they work.

For the remainder of the HVAC system, the team chose to place them in a mechanical loft in order to not consume limited and valuable square footage, however, through

a large access panel, visitors can see all of the other major components of the systems that heat and cool (heat pump air handler), ventilate (energy recovery ventilator), provide hot water (water heater) and provide the home with internet (switch). This access is also important for future maintenance.

Since Haven Studio is modestly-sized, at 550 SF, we plan to limit the number of occupants in the home during the public exhibit to twenty at one time. With five members of the stationed through the home, this will create an intimate experience where each student can explain the design concepts, systems, components, and materials to a small group. However, since the project is adjacent to the University of Kansas' Designbuild Center, we also have the opportunity to create a second exhibit there with a collection of the materials that are not visible in the finished product yet are essential in performance. We will also provide a slideshow of the construction process and allow visitors to virtually tour the building during its construction through the first Matterport tour.

As a living laboratory, Haven Studio will serve as a classroom space for students who will use its lessons to inform future designbuild projects, such as an upcoming collaboration with a local non-profit organization to deliver small, sustainable, affordable housing to our local community.



Haven Studio, rendering of interior showing the main studio space looking east, with shades closed

FUTURE PLANS FOR HAVEN STUDIO

Haven Studio is staying put (although it was designed to be able to move, if necessary). Future students will benefit from this project by interacting with the living lab. This project will be a case study example for learning about environmental systems in a residential application. All the systems will be expressed and diagrammed to make this knowledge accessible. The space itself will also function as a clean and quiet space for design collaboration and meeting with outside partners or clients separate from the main Designbuild Center, which is often dusty and loud from ongoing construction projects. The *residential studio* (open concept kitchen / dining / living room / bedroom) will convert to the *academic studio* (conference room / meeting space to discuss design ideas for future designbuild studios); the living room cabinetry will transform into a materials library; the living room television will be adapted as a presentation and video conference tool to facilitate design collaboration.

Finally, the exterior of the house facing the street will serve as a wayfinding element to help new students and community partners visiting the currently unmarked KU Designbuild Center know that they have arrived.

The broader community will continue to benefit from this project beyond the Solar Decathlon competition. Already, before its completion, Haven Studio is serving as a catalyst. The University of Kansas has created a partnership with a

local non-profit organization to provide one affordable house design and one built version of this design each year for the next several years. These small homes will be designed, using Haven Studio as a model, to address: 1) the rising cost of homes in the area; 2) the scarcity of homes in the area; and 3) the imperative to design and build more sustainable homes.

COMMUNITY EXHIBITION DATES AND TIMES

Dirt Works Studio will host community exhibition events at Haven Studio and the KU Designbuild Center, 3813 Greenway Drive, Lawrence, Kansas 66046, on the following dates/times:

- Thursday, April 13, from 9:00 - 12:00
- Friday, April 14, from 9:00 - 3:00
- Saturday, April 15, from 10:00 - 4:00
- Sunday, April 16, from 1:00 - 4:00

The main event will be held on Saturday, April 15, and will include our ribbon-cutting ceremony, at 10:00 am, followed by home tours and activities. Parking will be readily available, including accessible parking. Haven Studio will be fully accessible, as is the neighboring KU Designbuild Center.