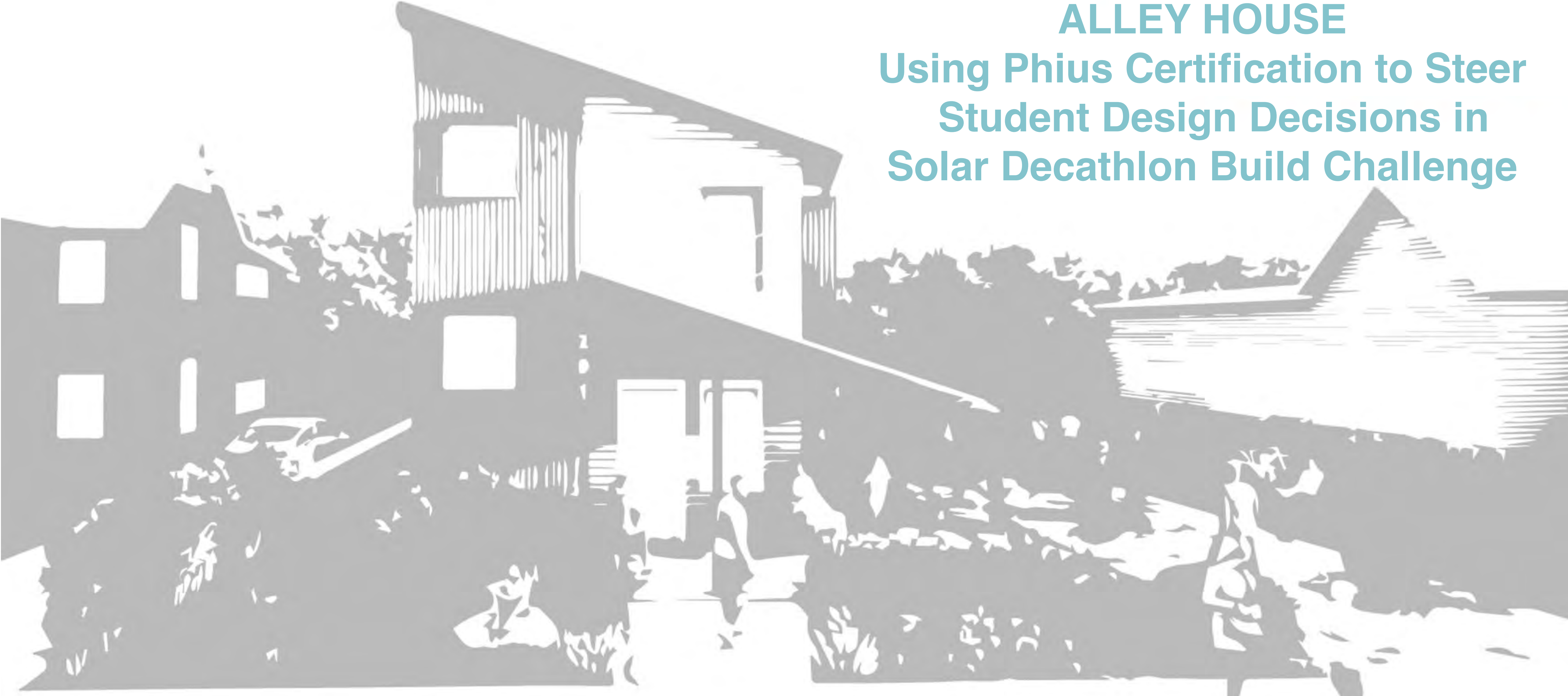


ALLEY HOUSE
Using Phius Certification to Steer Student Design Decisions in Solar Decathlon Build Challenge

Pam Harwood, AIA, NCARB
Professor of Architecture
Ball State University

Emily Rheinheimer
Graduate Architect
Ball State University

Dan Porzel, CPHB, Leed AP
Owner / Builder
Cedar Street Builders

Walter Grondzik, PE, CPHC
Emeriti Professor of Architecture
Ball State University

Phius Conference 2023 I Houston, Texas

November 8-11, 2023

First & Foremost, Alley House…

Is a local **affordable** housing solution to a global climate crisis, which disproportionately impacts the poor, vulnerable, and disenfranchised.

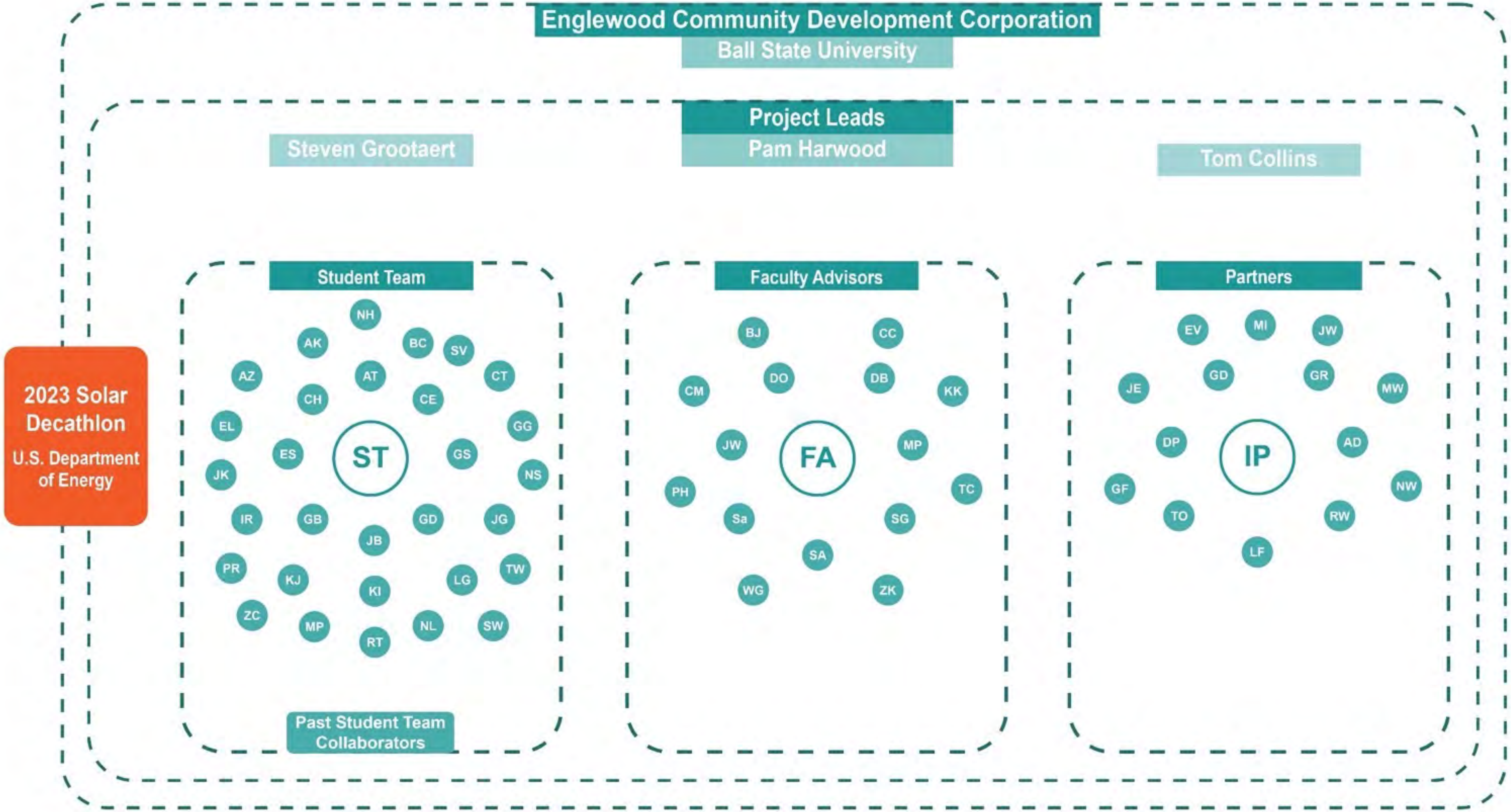
Employs **high-performance** building design to ensure the comfort, health, & well-being of low-income residents who often struggle to find quality affordable housing in the area & are being displaced due to gentrification pressure from market-rate urban development.

Uses onsite renewable **energy** production & other resource conservation measures to dramatically reduce monthly utility bills for residents, which can be a significant portion of their monthly income.

Acts as a catalyst for **sustainable** urban infill housing in an area struggling from decades of disinvestment, vacancy, & property abandonment to enhance quality of place & community interactions.

Introduction: The Alley House Design-Build

SD Team: Ball State University + Englewood



Englewood Community Development Corporation

Ball State University

Project Leads

Pam Harwood

Steven Grootaert

Tom Collins

Student Team

Faculty Advisors

Partners

Past Student Team Collaborators

2023 Solar Decathlon

U.S. Department of Energy

Student Team Lead
(Spencer W, Navy L

Construction Officer
(Garrett S, Eric L

Measure Contest Officer
Alejandro F, Javier B

Community Outreach Officer
(Reshma T, Kristian I

Safety Officer
(Alex Bl, Andre K)

ST Student Team
AB - Adeline Baney
AH - Adam Horkay
AF - Alejandro A. Flores
AB - Alex Bleiweis
AZ - Amelia Zaharako
AK - Andre King
AT - Angel Teter-McCurdy
BC - Brittney Castro
CT - Caeley Taylor
CH - Carsyn Houser
CE - Christina Ellett
EL - Eric Lohse
ES - Essince Smith
GS - Garrett Stritzel
GG - Gillian Gagnon
GB - Grace Brisco
GD - Grace Dale
IR - Isaac Reinoehl
JB - Javier Barrera
JG - Joshua Gee
JK - Juli Kurnos
KJ - Katelin Johnson
KI - Kristian Irving
LG - Lauren Green Isch
MP - Molly Page
NH - Nathan Horlander
NL - Navy Lynch
NS - Nik Seiber
PR - Peyton Roedel
RT - Reshma Talukder
SV - Spencer Vredingburgh
SW - Spencer Whitmore
TW - Tanner Williams
ZC - Zoe Conrad

FA Faculty Advisors
BJ - Brad Johnston
CC - Caitlin Cameron
CM - Chris Marlow
DO - Dan Overbey
DB - Donna Browne
KK - Karen Keddy
JW - John West
MP - Megan Phillippe
PH - Pamela Harwood
Sa - Sarah Alfaro
SA - Sherif Attallah
SG - Steve Gootaert
TC - Tom Collins
WG - Walter Grondzik
ZK - Zahida Khan

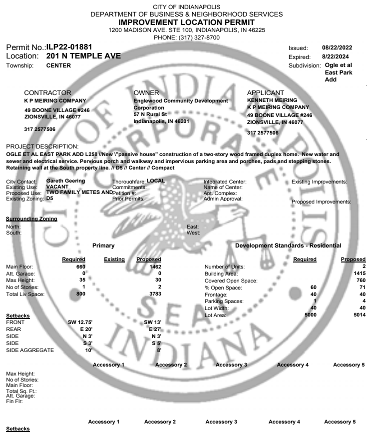
Past Student Team Collaborators
AL - Alejandra Lagunas
ER - Emily Rheinheimer
IW - Isaac Wilson
KJ - Kendall Johnson
MM - Matt Martella
MA - Mitchell Archer
NB - Noah Bueniing
SS - Soumi Sarkar
SB - Savannah Barnhart
Ss - Shraddha Shetty
NS - Nik Seiber
NE - Nourhan Elboraei
SB - Sara Bone
SR - Shabnam Ragani
AJ - Allison Janik
BR - Bailey Rice
Mm - Melanie Miller
MG - Morgan Getz
CT - Claire Thurlow
DN - Drayson Nespo
EM - Eva Martin
KG - Kaitlin Gobrogge
OK - Oeth Keller
DB - Derek Bohm
TB - Taylor Bott
AK - Allan Killion
Ak - Andre King
SR - Shabnam Rajani
WW - Winnie Wang

IP Industry Partners
EV - EcoVantage
JW - Jason Wolfe
JE - Jefferson Electrics
GD - Gratus Development
GR - Greenheck
MW - McComb Window Company
DP - Dan Porzel
AD - Angela DeRose
GF - Green Fiber Cellulose
NW - Nu-wool
TO -Thermafiber Owens Corning
RW - Rockwool
LF - Legolett Sgg hi Allie
Frost Proof Foundation
Irving Materials Concrete
MI - Mitsubishi

Solar Decathlon 2023 Awards: We WON!


U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON
20th ANNIVERSARY
BUILDING IMPACT FOR 20 YEARS
2002-2022

Solar Decathlon Local Build 2023: Ball State



CITY OF INDIANAPOLIS
DEPARTMENT OF BUSINESS & NEIGHBORHOOD SERVICES
IMPROVEMENT LOCATION PERMIT
1200 MADISON AVE. STE 100, INDIANAPOLIS, IN 46225
PHONE: (317) 327-8700

Permit No.: **ILP22-01881**
Location: **201 N TEMPLE AVE**
Township: **CENTER**
Issued: **08/22/2022**
Expired: **8/22/2024**
Subdivision: **Ogle et al East Park Add**

CONTRACTOR	OWNER	APPLICANT
K P MEIRING COMPANY **49 BOONE VILLAGE #246** **ZIONSVILLE, IN 46077** **317 2577506**	**Englewood Community Development Corporation** **57 N Rural St** **Indianapolis, IN 46201**	**KENNETH MEIRING** **K P MEIRING COMPANY** **49 BOONE VILLAGE #246** **ZIONSVILLE, IN 46077** **317 2577506**

PROJECT DESCRIPTION:
OGLE ET AL EAST PARK ADD L258 //New \"passive house" construction of a two-story wood framed duplex home. New water and sewer and electrical service. Pervious porch and walkway and impervious parking area and porches, pads and stepping stones. Retaining wall at the South property line. // D5 // Center // Compact

City Contact: **Gareth Geering**
Existing Use: **VACANT**
Proposed Use: **TWO FAMILY METES AND**
Existing Zoning: **D5**
Thoroughfare: **LOCAL**
Commitments:
Petition #:
Prior Permits:
Integrated Center:
Name of Center:
Apt. Complex:
Admin Approval:
Existing Improvements:
Proposed Improvements:

Surrounding Zoning
North:
South:
East:
West:

Primary

	Required	Existing	Proposed
Main Floor:	660		1462
Att. Garage:	0		0
Max Height:	35		30
No of Stories:	1		2
Total Liv Space:	800		3783

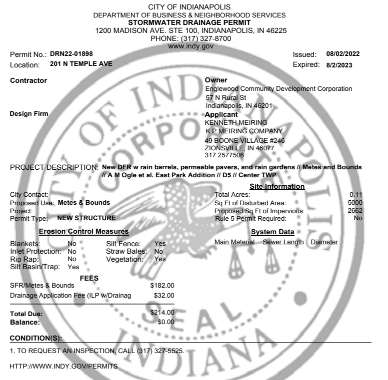
Development Standards - Residential

	Required	Proposed
Number of Units:		2
Building Area:		1415
Covered Open Space:		760
% Open Space:	60	71
Frontage:	40	40
Parking Spaces:	1	4
Lot Width:	40	40
Lot Area:	5000	5014

Setbacks		
FRONT	SW 12.75'	SW 13'
REAR	E 20'	E 27'
SIDE	N 3'	N 3'
SIDE	S 3'	S 5'
SIDE AGGREGATE	10'	8'

	Accessory 1	Accessory 2	Accessory 3	Accessory 4	Accessory 5
Max Height:					
No of Stories:					
Main Floor:					
Total Sq. Ft.:					
Att. Garage:					
Fin Flr:					

	Accessory 1	Accessory 2	Accessory 3	Accessory 4	Accessory 5
Setbacks					



CITY OF INDIANAPOLIS
DEPARTMENT OF BUSINESS & NEIGHBORHOOD SERVICES
STORMWATER DRAINAGE PERMIT
1200 MADISON AVE. STE 100, INDIANAPOLIS, IN 46225
PHONE: (317) 327-8700
www.indy.gov

Permit No.: **DRN22-01898**
Location: **201 N TEMPLE AVE**
Issued: **08/02/2022**
Expired: **8/2/2023**

Contractor

Design Firm

Owner
Englewood Community Development Corporation
57 N Rural St
Indianapolis, IN 46201

Applicant
KENNETH MEIRING
K P MEIRING COMPANY
49 BOONE VILLAGE #246
ZIONSVILLE, IN 46077
317 2577506

PROJECT DESCRIPTION: **New DFR w rain barrels, permeable pavers, and rain gardens // Metes and Bounds // A M Ogle et al. East Park Addition // D5 // Center TWP**

City Contact:
Proposed Use: **Metes & Bounds**
Project:
Permit Type: **NEW STRUCTURE**

Site Information

Total Acres:	0.11
Sq Ft of Disturbed Area:	5000
Proposed Sq Ft of Impervious:	2662
Rule 5 Permit Required:	No

Erosion Control Measures

Blankets:	No	Silt Fence:	Yes
Inlet Protection:	No	Straw Bales:	No
Rip Rap:	No	Vegetation:	Yes
Silt Basin/Trap:	Yes		

System Data

Main Material	Sewer Length	Diameter

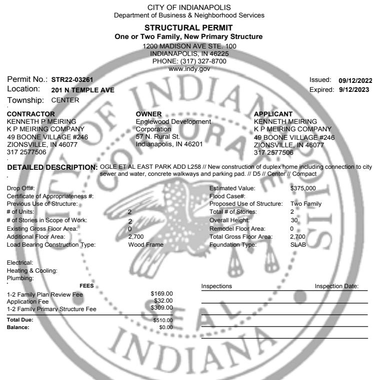
FEES

SFR/Metes & Bounds	$182.00
Drainage Application Fee (ILP w/Drainag	$32.00
Total Due:	$214.00
Balance:	$0.00

CONDITION(S):

1. TO REQUEST AN INSPECTION, CALL (317) 327-5525.

HTTP://WWW.INDY.GOV/PERMITS



CITY OF INDIANAPOLIS
Department of Business & Neighborhood Services
STRUCTURAL PERMIT
One or Two Family, New Primary Structure
1200 MADISON AVE STE. 100
INDIANAPOLIS, IN 46225
PHONE: (317) 327-8700
www.indy.gov

Permit No.: **STR22-03261**
Location: **201 N TEMPLE AVE**
Township: CENTER
Issued: **09/12/2022**
Expired: **9/12/2023**

CONTRACTOR	OWNER	APPLICANT
KENNETH P MEIRING K P MEIRING COMPANY 49 BOONE VILLAGE #246 ZIONSVILLE, IN 46077 317 2577506	Englewood Development Corporation 57 N. Rural St. Indianapolis, IN 46201	KENNETH MEIRING K P MEIRING COMPANY 49 BOONE VILLAGE #246 ZIONSVILLE, IN 46077 317 2577506

DETAILED DESCRIPTION: OGLE ET AL EAST PARK ADD L258 // New construction of duplex home including connection to city sewer and water, concrete walkways and parking pad. // D5 // Center // Compact

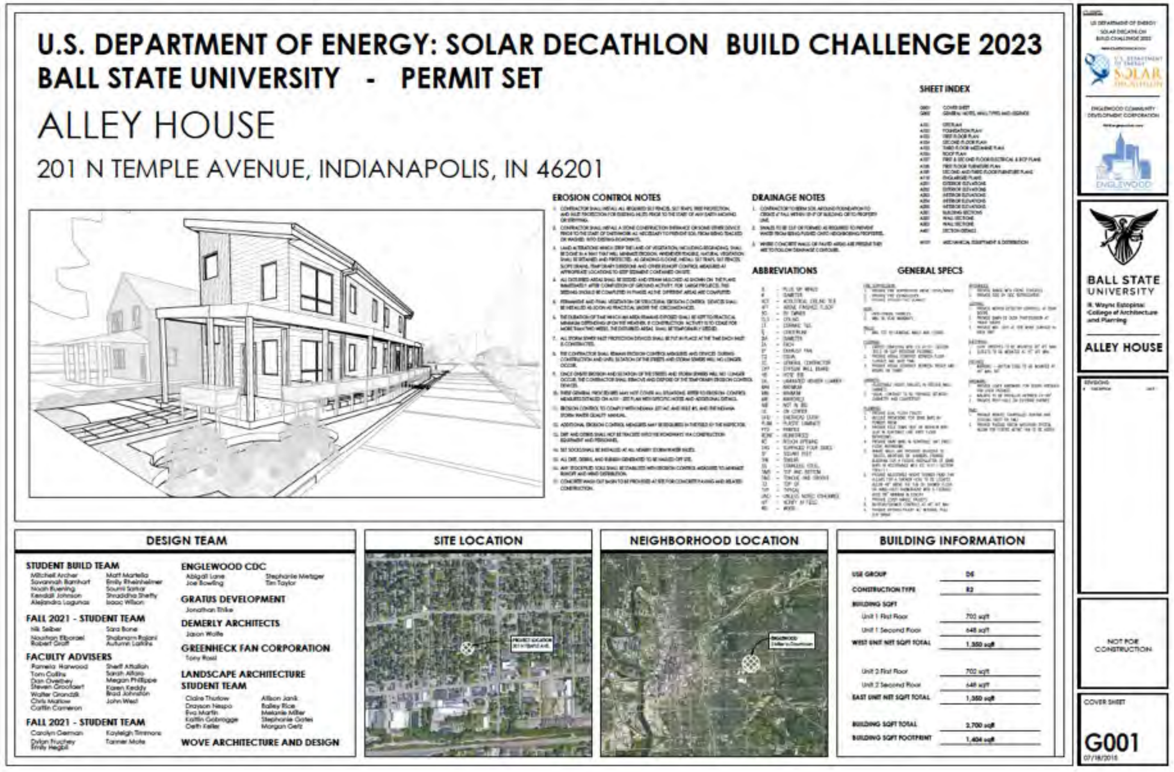
Drop Off#:		Estimated Value:	$375,000
Certificate of Appropriateness #:		Flood Case#:	
Previous Use of Structure:		Proposed Use of Structure:	Two Family
# of Units:	2	Total # of Stories:	2
# of Stories in Scope of Work:	2	Overall Height:	30
Existing Gross Floor Area:	0	Remodel Floor Area:	0
Additional Floor Area:	2,700	Total Gross Floor Area:	2,700
Load Bearing Construction Type:	Wood Frame	Foundation Type:	SLAB

Electrical:
Heating & Cooling:
Plumbing:

FEES

1-2 Family Plan Review Fee	$169.00
Application Fee	$32.00
1-2 Family Primary Structure Fee	$309.00
Total Due:	$510.00
Balance:	$0.00

Inspections	Inspection Date:



U.S. DEPARTMENT OF ENERGY: SOLAR DECATHLON BUILD CHALLENGE 2023
BALL STATE UNIVERSITY - PERMIT SET
ALLEY HOUSE
201 N TEMPLE AVENUE, INDIANAPOLIS, IN 46201

SHEET INDEX

EROSION CONTROL NOTES

DRAINAGE NOTES

ABBREVIATIONS

GENERAL SPECS

DESIGN TEAM

STUDENT BUILD TEAM
Mitchell Archer
Savannah Barnhart
Noah Buening
Kendall Johnson
Alejandra Lagunas
Matt Martella
Emily Rheinheimer
Soumi Sarkar
Shraddha Shetty
Isaac Wilson

FALL 2021 - STUDENT TEAM
Nik Seiber
Noureen Elboraei
Robert Graff
Sara Bone
Shabnam Rajani
Autumn LaMire

FACULTY ADVISERS
Pamela Harwood
Tom Collins
Dan Overbey
Steven Grootaert
Walter Grondzik
Chris Marlow
Caitlin Cameron
Sherif Attallah
Sarah Altaro
Megan Phillippe
Karen Keddy
Brad Johnston
John West

FALL 2021 - STUDENT TEAM
Carolyn German
Dylan Truchey
Emily Hegbli
Kayleigh Timmons
Tanner Mote

ENGLEWOOD CDC
Abigail Lane
Joe Bowling
Stephanie Metzger
Tim Taylor

GRATUS DEVELOPMENT
Jonathan Thike

DEMERLY ARCHITECTS
Jason Wolfe

GREENHECK FAN CORPORATION
Tony Rossi

LANDSCAPE ARCHITECTURE STUDENT TEAM
Claire Thurlow
Drayson Nespo
Eva Martin
Kaitlin Gobrogge
Oeth Keller
Allison Janik
Bailey Rice
Melanie Miller
Stephanie Gates
Morgan Getz

WOVE ARCHITECTURE AND DESIGN

SITE LOCATION

NEIGHBORHOOD LOCATION

BUILDING INFORMATION

USE GROUP	D5
CONSTRUCTION TYPE	R3
BUILDING SQFT	
Unit 1 First Floor	702 sqft
Unit 1 Second Floor	648 sqft
WEST UNIT NET SQFT TOTAL	1,350 sqft
Unit 2 First Floor	702 sqft
Unit 2 Second Floor	648 sqft
EAST UNIT NET SQFT TOTAL	1,350 sqft
BUILDING SQFT TOTAL	2,700 sqft
BUILDING SQFT FOOTPRINT	1,404 sqft

ENGLEWOOD COMMUNITY DEVELOPMENT CORPORATION

BALL STATE UNIVERSITY
R. Wayne Estopinal College of Architecture and Planning

ALLEY HOUSE

REVISIONS

NOT FOR CONSTRUCTION

COVER SHEET
G001
07/18/2018

Solar Decathlon 2023: Build Locally

Build Challenge

RESIDENTIAL

Build Locally
↓
Compete Nationally

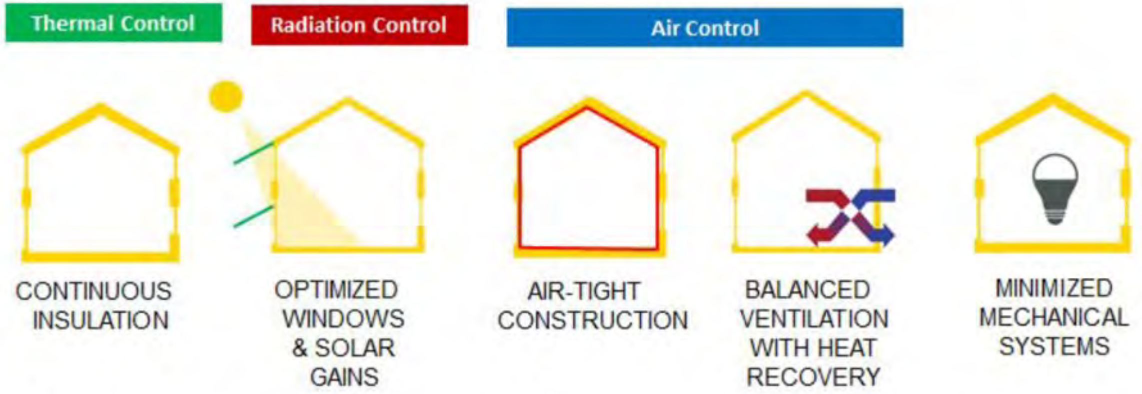
10 CONTESTS

- Architecture
- Engineering
- Market Analysis
- Durability and Resilience
- Embodied Environmental Impact
- Integrated Performance
- Occupant Experience
- Comfort and Environmental Quality
- Energy Performance
- Presentation

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

Phius Prescriptive Path

PASSIVE BUILDING PRINCIPLES



5 Thermal Enclosure
6 Moisture Risk Limitation

4 Solar Protection

2 Air - Tightness

7 Mechanical Ventilation

8 Mechanical Systems

phius CORE Prescriptive

1
SCOPE LIMITATIONS

2
AIR TIGHTNESS

3
COMPACTNESS

4
SOLAR PROTECTION

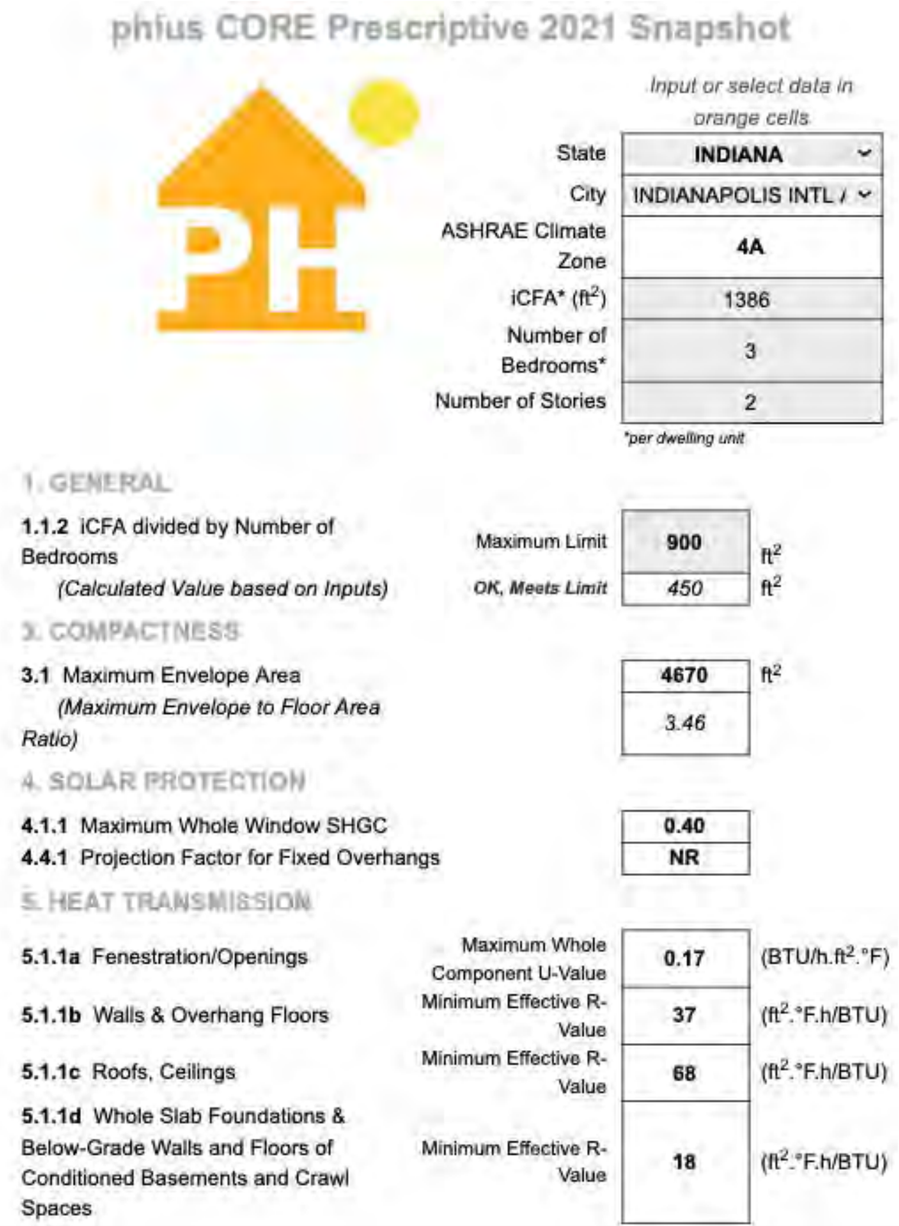
5
THERMAL ENCLOSURE

6
MOISTURE RISK LIMITATION

7
MECHANICAL VENTILATION

8
MECHANICAL SYSTEMS

9
LIGHTING, APPLIANCES, & HOT WATER



phius CORE Prescriptive 2021 Snapshot

Input or select data in orange cells

State	INDIANA
City	INDIANAPOLIS INTL /
ASHRAE Climate Zone	4A
iCFA* (ft^2)	1386
Number of Bedrooms*	3
Number of Stories	2

*per dwelling unit

1. GENERAL

1.1.2 iCFA divided by Number of Bedrooms	Maximum Limit	900	ft^2
(Calculated Value based on Inputs)	***OK, Meets Limit***	*450*	ft^2

3. COMPACTNESS

3.1 Maximum Envelope Area	4670	ft^2
(Maximum Envelope to Floor Area Ratio)	*3.46*	

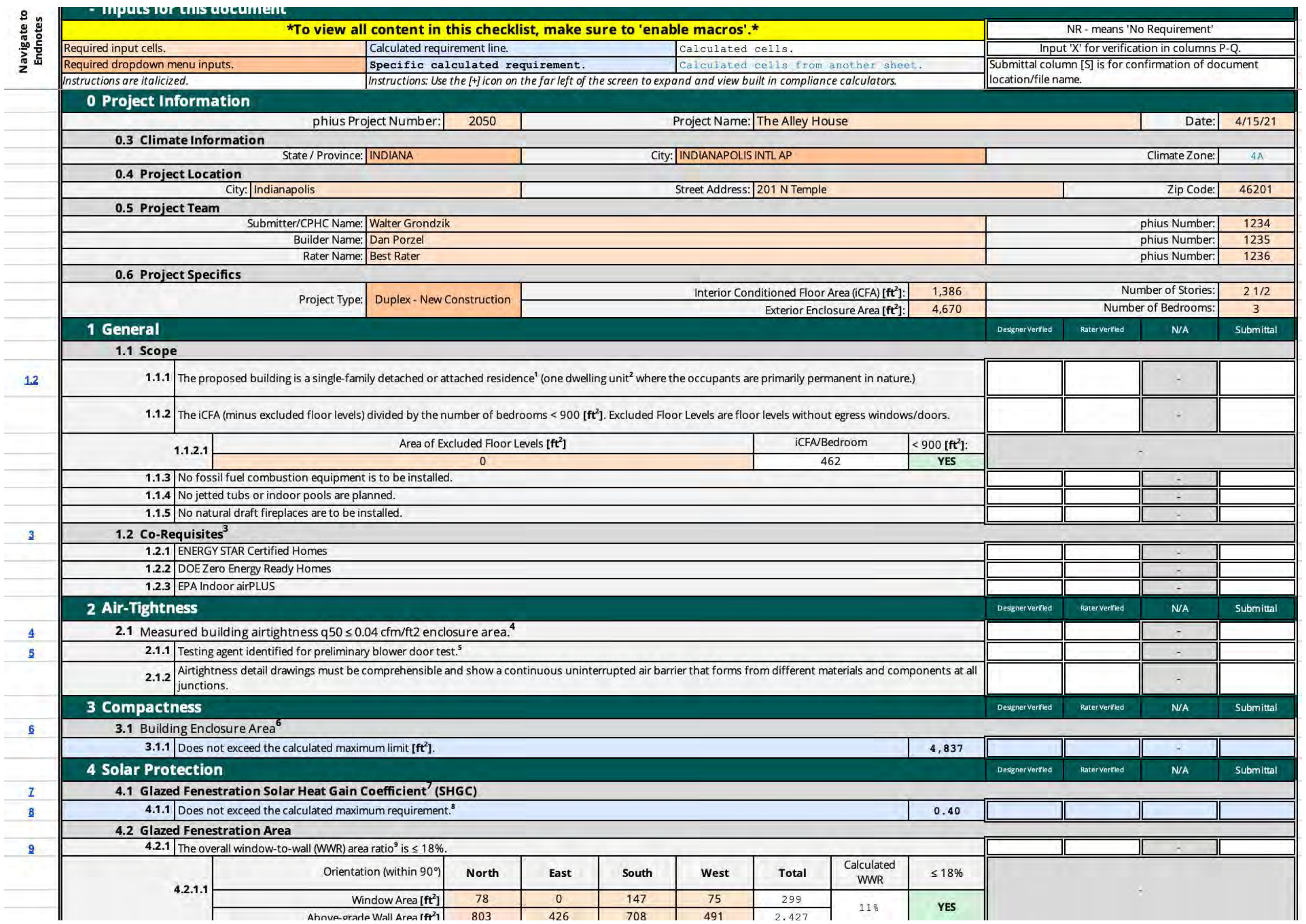
4. SOLAR PROTECTION

4.1.1 Maximum Whole Window SHGC	0.40
4.4.1 Projection Factor for Fixed Overhangs	NR

5. HEAT TRANSMISSION

5.1.1a Fenestration/Openings	Maximum Whole Component U-Value	0.17	(BTU/h.ft^2.°F)
5.1.1b Walls & Overhang Floors	Minimum Effective R-Value	37	(ft^2.°F.h/BTU)
5.1.1c Roofs, Ceilings	Minimum Effective R-Value	68	(ft^2.°F.h/BTU)
5.1.1d Whole Slab Foundations & Below-Grade Walls and Floors of Conditioned Basements and Crawl Spaces	Minimum Effective R-Value	18	(ft^2.°F.h/BTU)

Phius Prescriptive Path



Navigate to Endnotes

- Inputs for this document

To view all content in this checklist, make sure to 'enable macros'.

NR - means 'No Requirement'

Required input cells. | Calculated requirement line. | `Calculated cells.`

Input 'X' for verification in columns P-Q.

Required dropdown menu inputs. | **`Specific calculated requirement.`** | `Calculated cells from another sheet.`

Instructions are italicized. | *Instructions: Use the [+] icon on the far left of the screen to expand and view built in compliance calculators.*

Submittal column [S] is for confirmation of document location/file name.

0 Project Information

phius Project Number: 2050
Project Name: The Alley House
Date: 4/15/21

0.3 Climate Information

State / Province: INDIANA
City: INDIANAPOLIS INTL AP
Climate Zone: 4A

0.4 Project Location

City: Indianapolis
Street Address: 201 N Temple
Zip Code: 46201

0.5 Project Team

Submitter/CPHC Name: Walter Grondzik
phius Number: 1234
Builder Name: Dan Porzel
phius Number: 1235
Rater Name: Best Rater
phius Number: 1236

0.6 Project Specifics

Project Type: Duplex - New Construction
Interior Conditioned Floor Area (iCFA) **[ft^2]**: 1,386
Exterior Enclosure Area **[ft^2]**: 4,670
Number of Stories: 2 1/2
Number of Bedrooms: 3

		Designer Verified	Rater Verified	N/A	Submittal
	1 General				
	1.1 Scope				
1.2	**1.1.1** The proposed building is a single-family detached or attached residence[1] (one dwelling unit[2] where the occupants are primarily permanent in nature.)			-	
	1.1.2 The iCFA (minus excluded floor levels) divided by the number of bedrooms < 900 **[ft^2]**. Excluded Floor Levels are floor levels without egress windows/doors.			-	
	1.1.3 No fossil fuel combustion equipment is to be installed.			-	
	1.1.4 No jetted tubs or indoor pools are planned.			-	
	1.1.5 No natural draft fireplaces are to be installed.			-	
3	**1.2 Co-Requisites[3]**				
	1.2.1 ENERGY STAR Certified Homes			-	
	1.2.2 DOE Zero Energy Ready Homes			-	
	1.2.3 EPA Indoor airPLUS			-	
	2 Air-Tightness				
4	**2.1** Measured building airtightness q50 ≤ 0.04 cfm/ft2 enclosure area.[4]			-	
5	**2.1.1** Testing agent identified for preliminary blower door test.[5]			-	
	2.1.2 Airtightness detail drawings must be comprehensible and show a continuous uninterrupted air barrier that forms from different materials and components at all junctions.			-	
	3 Compactness				
6	**3.1** Building Enclosure Area[6]				
	3.1.1 Does not exceed the calculated maximum limit **[ft^2]**. `4,837`			-	
	4 Solar Protection				
7	**4.1 Glazed Fenestration Solar Heat Gain Coefficient[7] (SHGC)**				
8	**4.1.1** Does not exceed the calculated maximum requirement.[8] `0.40`				
	4.2 Glazed Fenestration Area				
9	**4.2.1** The overall window-to-wall (WWR) area ratio[9] is ≤ 18%.			-	

1.1.2.1

Area of Excluded Floor Levels **[ft^2]**	iCFA/Bedroom	< 900 **[ft^2]**:
0	462	YES

4.2.1.1

Orientation (within 90°)	North	East	South	West	Total	Calculated WWR	≤ 18%
Window Area **[ft^2]**	78	0	147	75	`299`	`11%`	YES
Above-grade Wall Area **[ft^2]**	803	426	708	491	`2,427`		

ALLEY HOUSE OVERVIEW

Sustainability: Equity – Economy - Environment

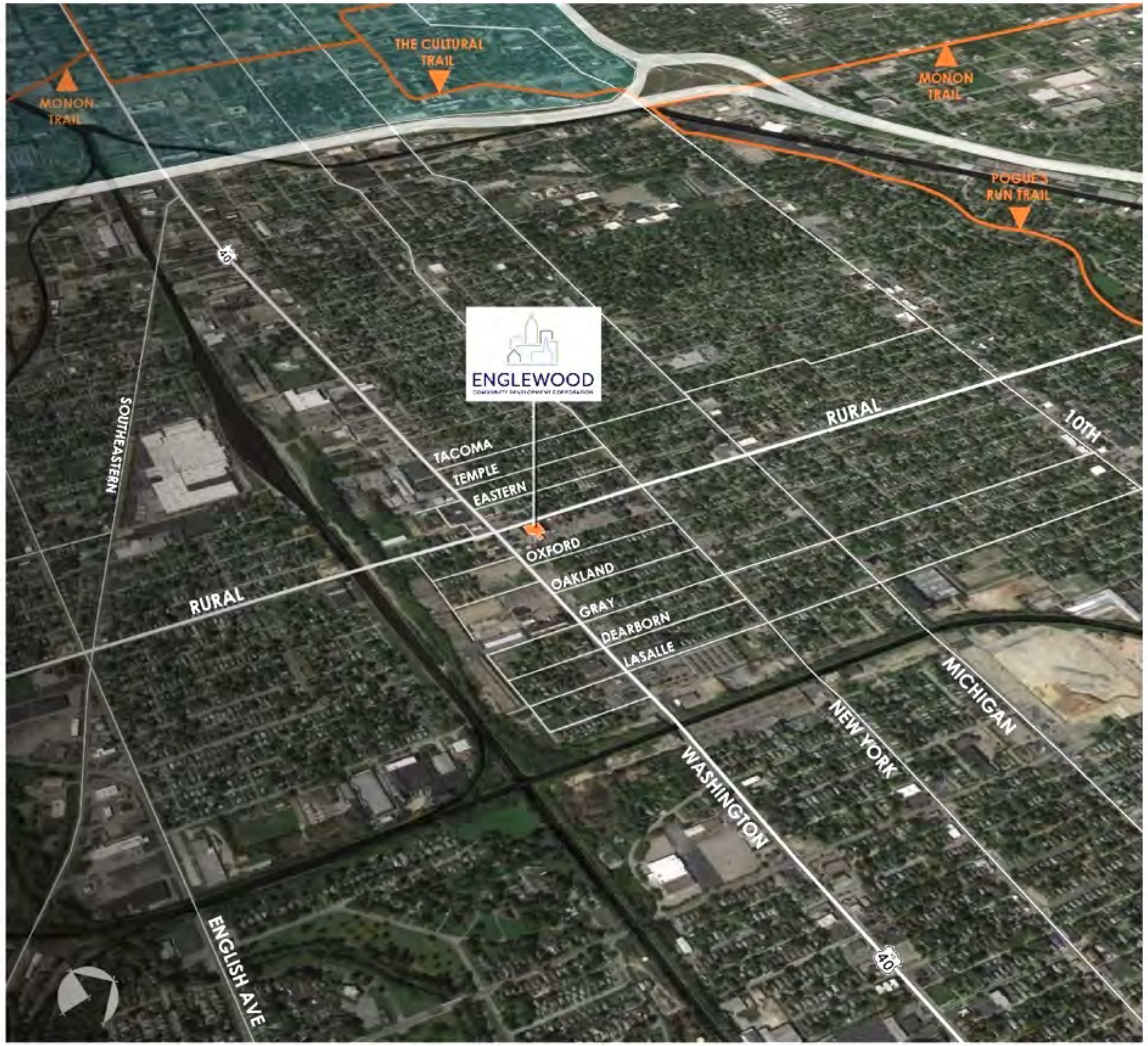
Design With Community

Engaged Student Involvement

The student engagement and community partnership over this two-year design build process has been transformative. Our community brought invaluable feedback to the team. We held open houses, exhibit displays, community participation sessions and work days, workshops with professional consultants, groundbreaking and ribbon cutting ceremonies, and a two-week public exhibit with over 1000 attendees to the Alley House. Students were engaged in every aspect of this project from design to construction to performance testing.

- Open House to solicit feedback on design Fall 2021
- "Advance to Build" Team Presentation Spring 2022
- Groundbreaking Ceremony Summer 2022
- Full-scale layout of house and educational centers
- DayStar children full-scale mockup of play space
- House Occupancy Testing Spring 2023
- Grand Opening to give thanks to over 200 partners
- Ribbon cutting with all having part of the ribbon
- Public exhibit student led tours Spring 2023
- Performance testing of the Alley House continues

Engaged Community Partner: Englewood



Livability

Promoting authentic and unique aspects of the area, utilizing PR Mallory as a central green space, providing a walkable environment for all ages, and improving basic infrastructure.

Opportunity

Encourage new development being walkable and attractive, promoting urban food growing and production, encouraging small businesses, and building off of the areas strengths.

Vitality

Supporting current neighbors while reducing vacancy. Welcoming new residential housing types to add density.

Education

Enhancing existing offerings, providing a community-focused local school, and providing education opportunities for all ages and to those who have fallen behind.

Community and Student Engagement

Ground Breaking Ceremony July 2022

DayStar Childcare Visit and Interaction with Prototype Modular Storage Bins June 2022

Soil Sample Collection July 2022

State Farm Neighborhood Assist Grant July 2022

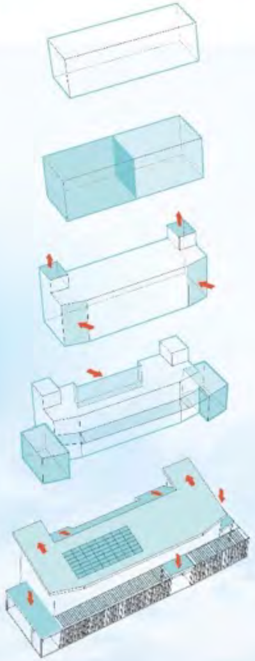
Community Open House CAP:INDY Fall 2021

THE ALLEY HOUSE

201 N TEMPLE AVE., INDIANAPOLIS, IN 46202

Just east of downtown Indianapolis is the lively neighborhood of Englewood, a multi-cultural, multi-generational place to live, work, worship, learn, and play. Like many post-industrial communities in the Midwest, Englewood has experienced population decline, reduced rates of educational attainment, decreasing median household incomes, and high vacancy rates. The recent affordable housing crisis and deteriorating existing building stock have made this neighborhood a target for outside developers who are building at a fast pace using low-quality construction materials and are contributing to rising property values. Higher property values bring a positive impact such as an influx of capital into the area and increased beautification efforts in the neighborhood; however, they also negatively impact residents in the displacement of original households and by changing in the social character of the neighborhood. Although affordable senior housing has been developed in the Near Eastside (NES) of Indianapolis, this has not effectively addressed the shortage of affordable housing for families.

Research indicates that vacant and abandoned properties in the Near Eastside neighborhood continue to disturb the communities' economy, health, welfare, and safety. Indianapolis is not sheltered from these harsh realities. Yet, communities often respond to difficulties by finding opportunities. One such opportunity is the plan of Cardinal Studio and Englewood Community Development Corporation (ECDC) to re-engage this neglected community by constructing multiple family housing units on vacant lots owned by Englewood CDC.



INITIAL VOLUME

Long south face toward alley

CREATE TWO UNITS

Short demising wall between units

EXTEND STAIR CORE & ACTIVATE THE ALLEY

Elevate stair angled wall for view to alley

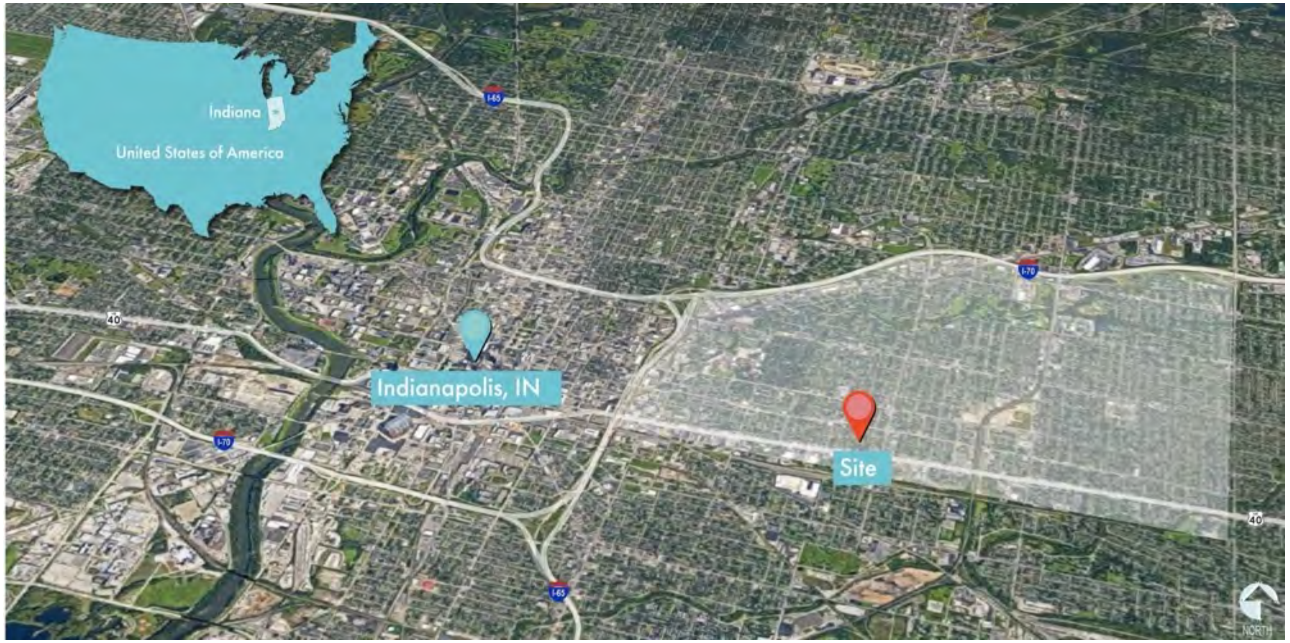
DEFINING ENTRANCES & SECOND FLOOR SPACES

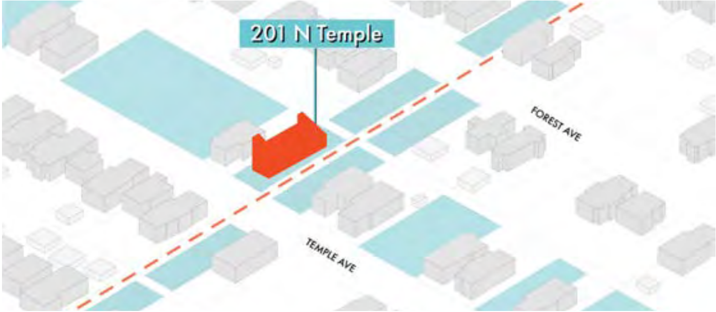
Porch placement and secondary entries

ROOF PITCH STUDY & ADDITION OF EAST AND WEST PORCHES

Addition of PV array on 4/12 pitch facing south

SOUTHWEST PERSPECTIVE

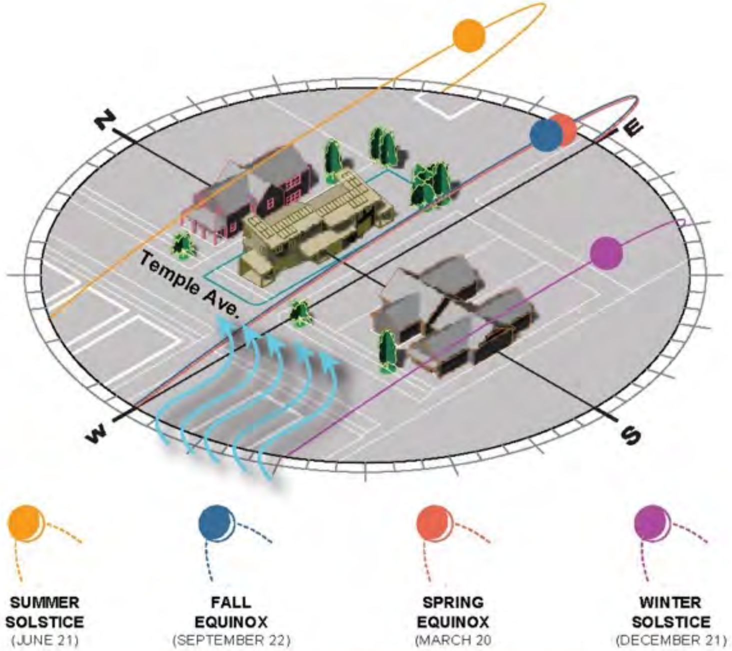




NORTHWEST PERSPECTIVE

SOUTHWEST BIRDS EYE PERSPECTIVE

Urban Design of the Alley House

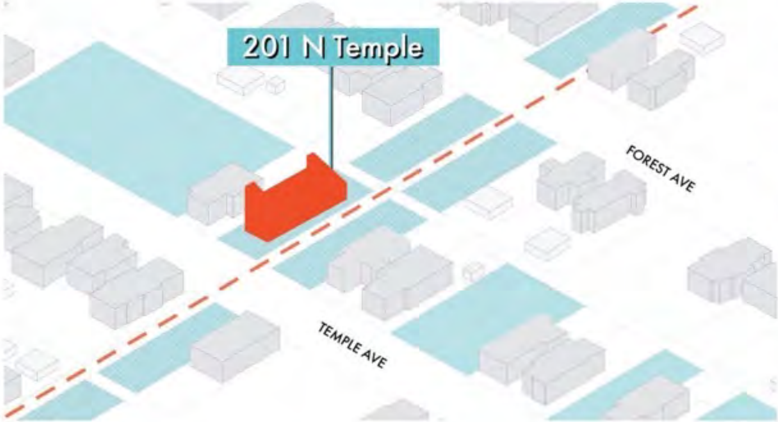


CLIMATE ZONE 5A | COLD | HUMID

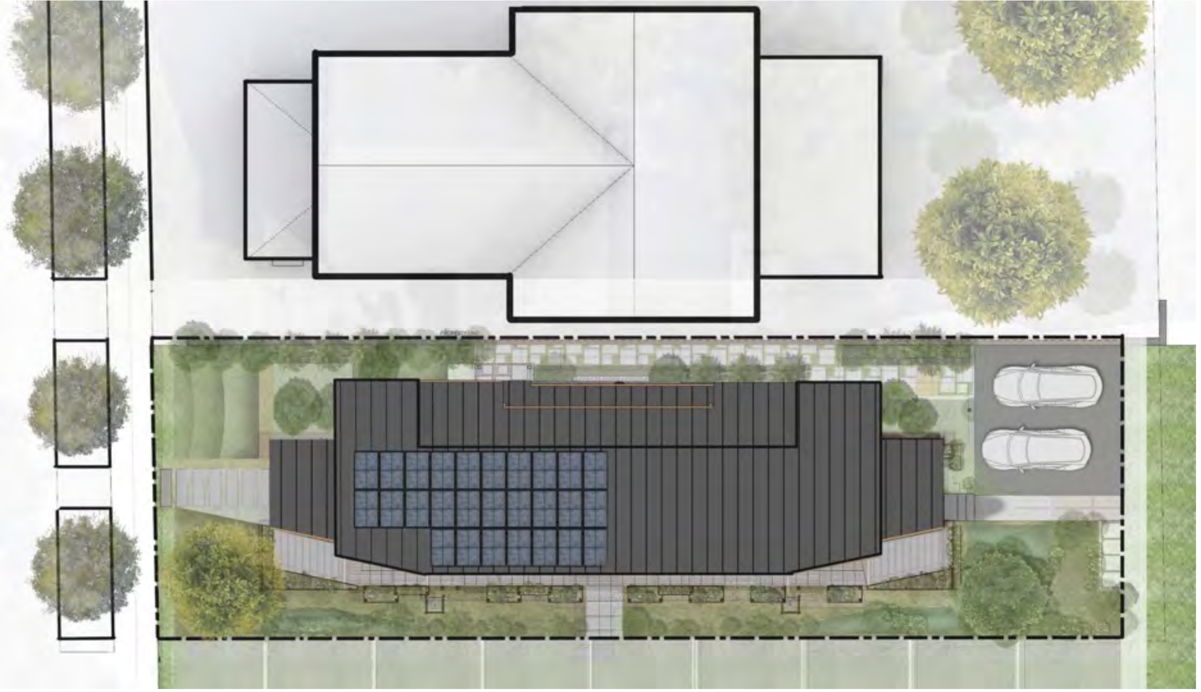
201 N TEMPLE AVE. INDIANAPOLIS, IN

Urban Design

The Alley House is an affordable housing solution to a global climate crisis which disproportionately impacts the poor, vulnerable, and disenfranchised. Students designed a high-performance building to ensure comfort, health, and well-being of low-income residents who struggle to find quality affordable housing and are being displaced due to gentrification pressure of market-rate development. The two-family Alley House is a prototype for urban infill along an east-west running alley where there are over 70% vacancies.



Site Selection, Analysis, and Planning



Site Section

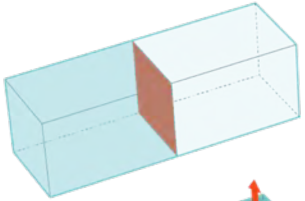
Form Development

INITIAL VOLUME

Long south face toward alley

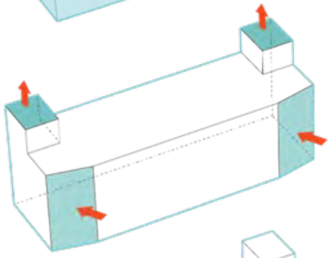
CREATE TWO UNITS

Short demising wall between units



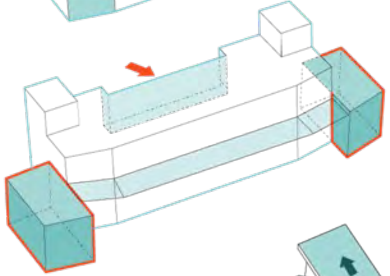
EXTEND STAIR CORE & ACTIVATE THE ALLEY

Elevate stair angled wall for view to alley



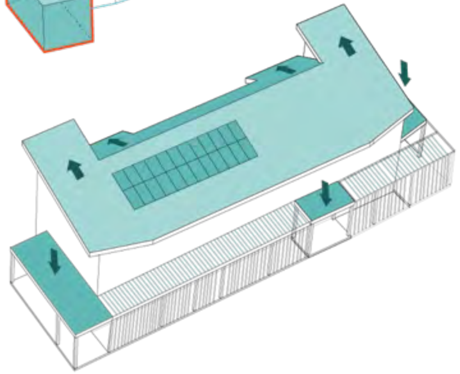
DEFINING ENTRANCES & SECOND FLOOR SPACES

Porch placement and secondary entries



ROOF PITCH STUDY & ADDITION OF EAST AND WEST PORCHES

Addition of PV array on 4/12 pitch facing south roof



Initial Volume

East-west elongated simple rectangle shape limited surface area and optimal solar orientation.

Create Two Units

Dividing the volume into two units, but giving both access to the south and the alley.

Stair Core & Alley Activation

Simple formal changes to create architectural interest, to address the alley/corner site, and provide for natural ventilation.

Defining Entrances & Spaces

Giving each unit a porch for transitional space and community interaction.

Roof Pitch Study & Addition of East and West Porches

Mono pitch to the south for optimal solar array orientation and area. Addition of pergola with the porches for creating enclosure for the connecting spaces.

First Floor Plan

FIRST FLOOR PLAN

Kitchen as the Heart of Home

Living Room with Media Wall

Second Floor Plan

2ND FLOOR PLAN

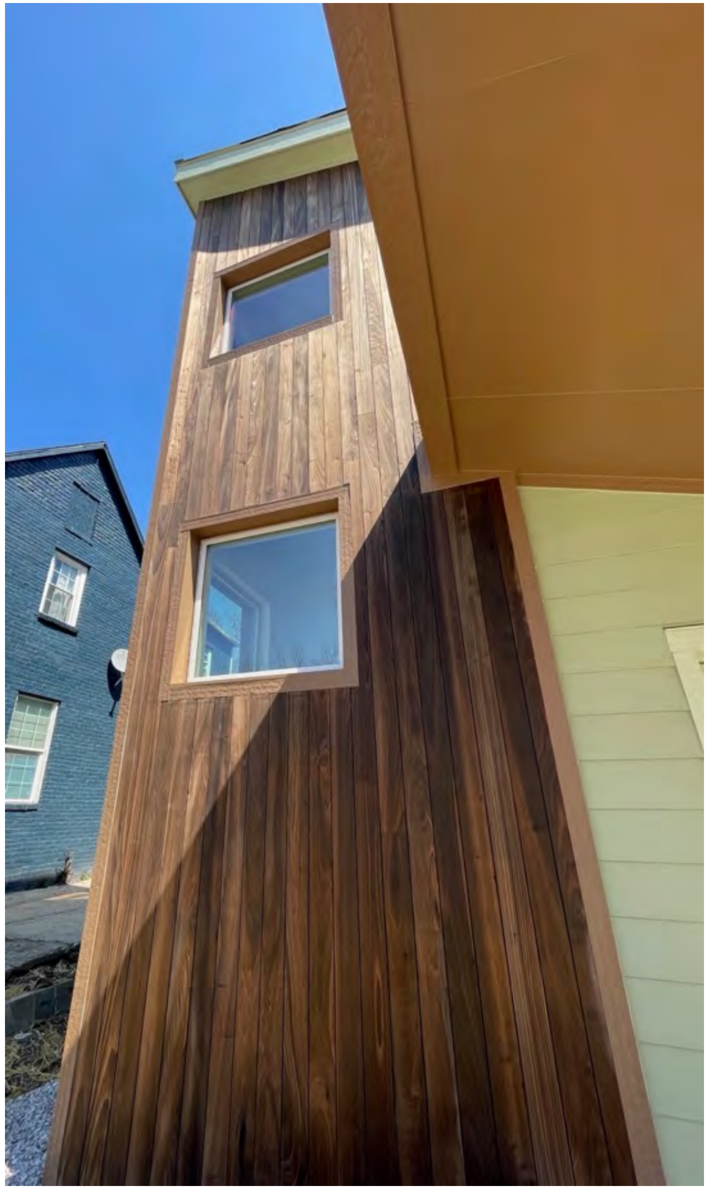
2ND FLOOR PLAN

1ST FLOOR PLAN

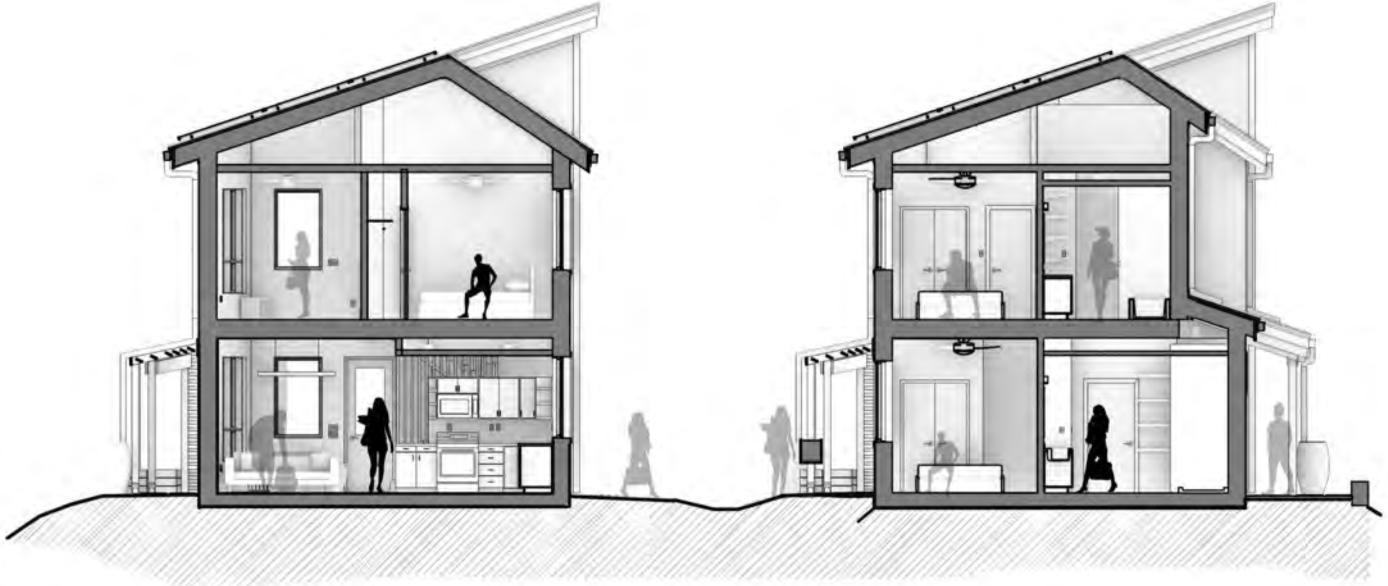
Upstairs Flex Space

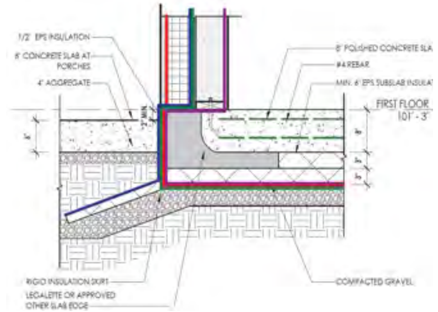
Upstairs Flex Space

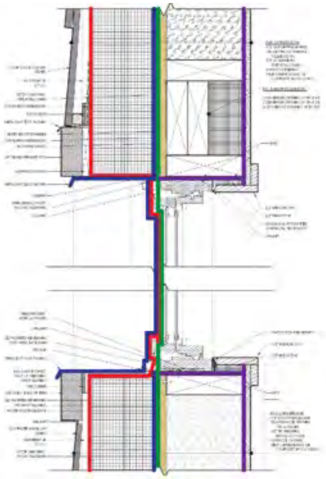
Mezzanine & Stack Ventilation

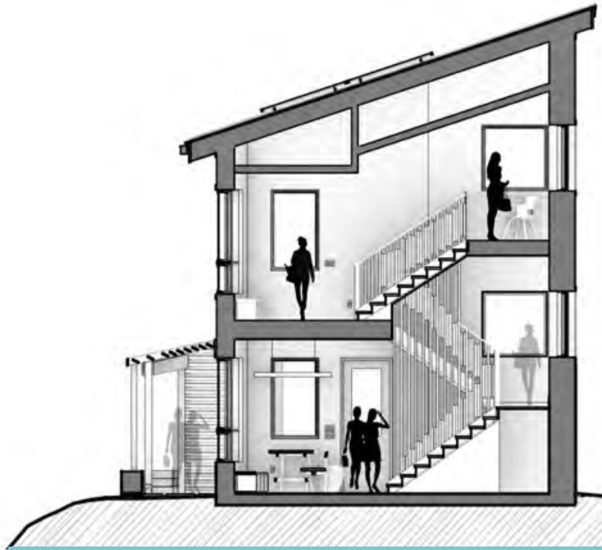


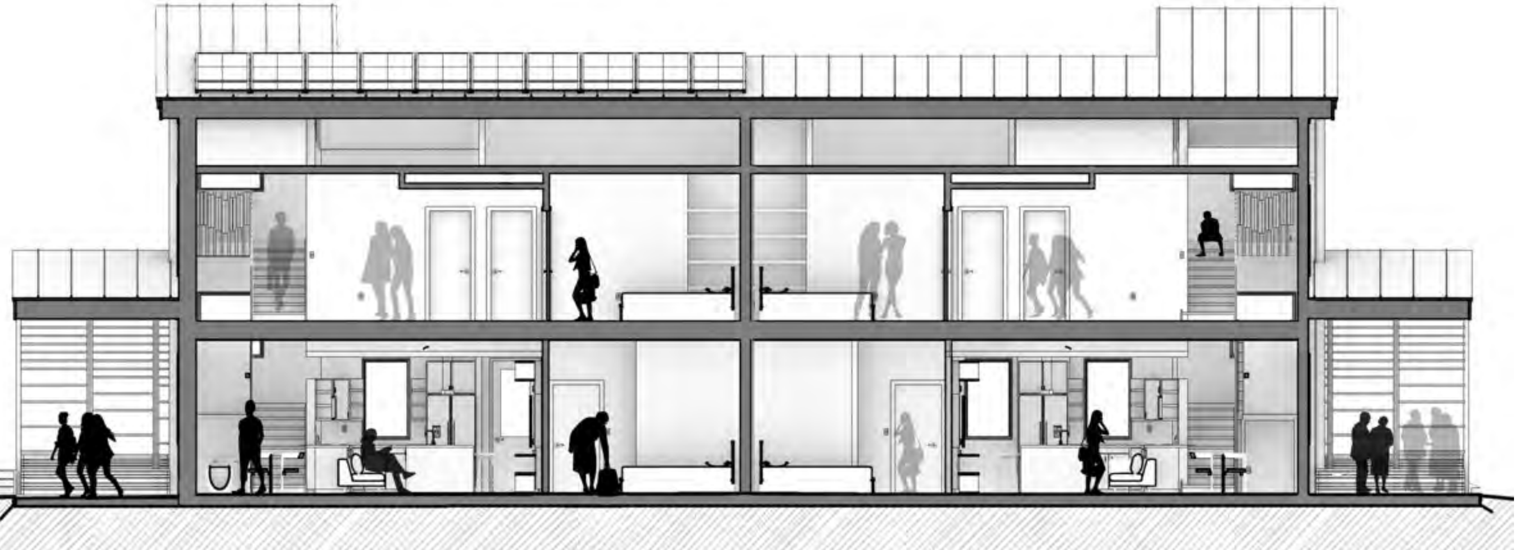
Alley House Sections & Details











Phius Conference 2023 I Houston, Texas

November 8-11, 2023

Alley House Elevations

West Elevation

South Elevation

North Elevation

East Elevation

Detail and Materiality of Alley House

Detail and Materiality

Angled walls on the corners frame alley views and create an inviting, welcoming presence. Sage green cement board and thermally-modified poplar blend Alley House with its environment. The biophilic design educates the community about green buildings; passersby can see the solar array on the roof, rain gardens, bioswales, shading devices, native plantings, and the corner stair towers for ventilation.

ALLEY HOUSE DESIGN PROCESS

Sustainability: Equity, Economy, Environment

Design For Equity

Equitable Community Design

Our neighborhood community development corporation began 25 years ago to help revitalize Near Eastside Indianapolis guided by principles of livability, opportunity, vitality, and education. The team embraced these principles in the design of the Alley House, addressing a sense of place, facilitating educational opportunities, incorporating sustainable site/building strategies, providing resilience and durability, addressing needs of residents at different life stages, and fostering equity and inclusion.

- Asset-based community design approach
- Site design promotes walkability/access to school
- Visibility of "green features" fosters education
- Arrangement of units promotes equity in access
- Alleyway as preferred neighborhood connector
- Provide east and west porches and gardens
- Design for a diversity of family types
- Consider how family will change over time
- 15-year rent-to-own leased at 30% and 50% AMI

Family Centered Housing Typologies

Variety of Family Types

The Alley House achieves the priorities of Architecture, Affordability, and Inclusivity set by the community and Englewood CDC where the median household income is $25,000 providing with-

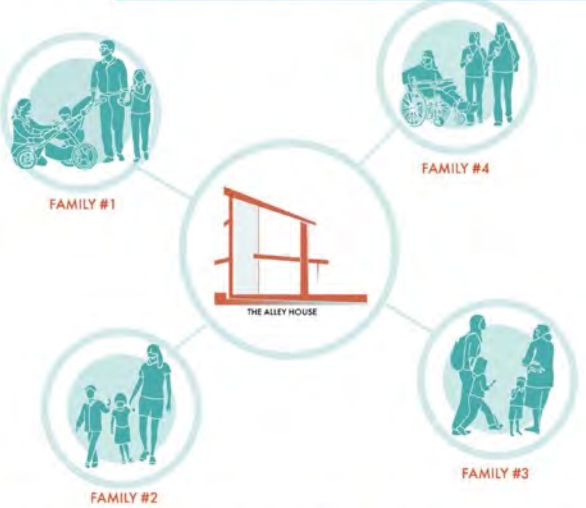
- Affordable & attainable housing
- Environmentally conscious designs

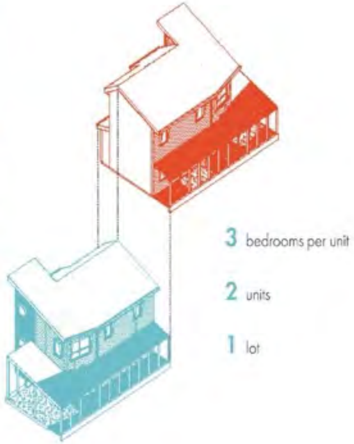
FAMILY#1
A family with couple and young children

FAMILY#2
A family with young children and single parent

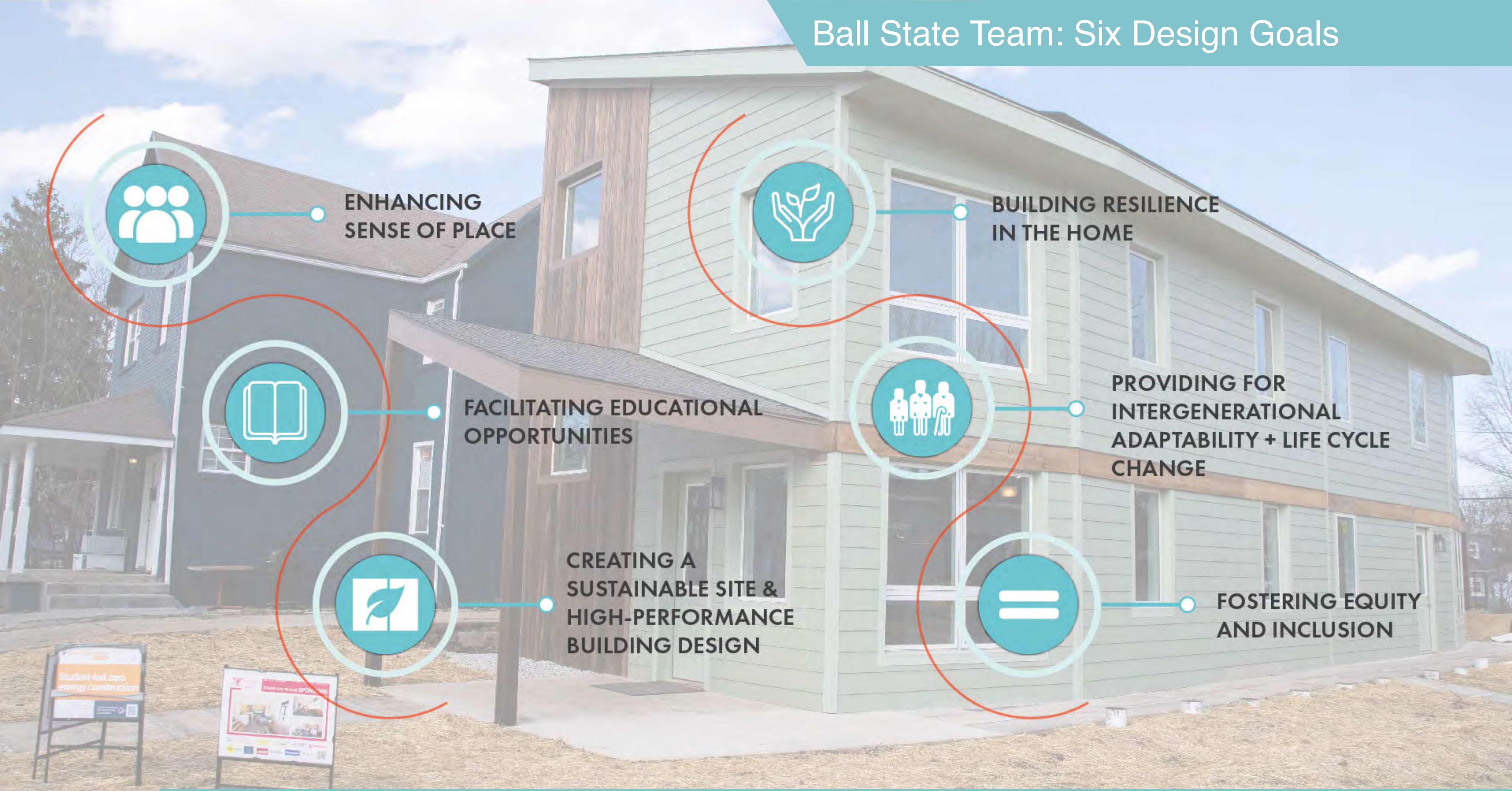
FAMILY#3
A family with elderly member

FAMILY#4
A family with specially able member





Ball State Team: Six Design Goals



ENHANCING SENSE OF PLACE

FACILITATING EDUCATIONAL OPPORTUNITIES

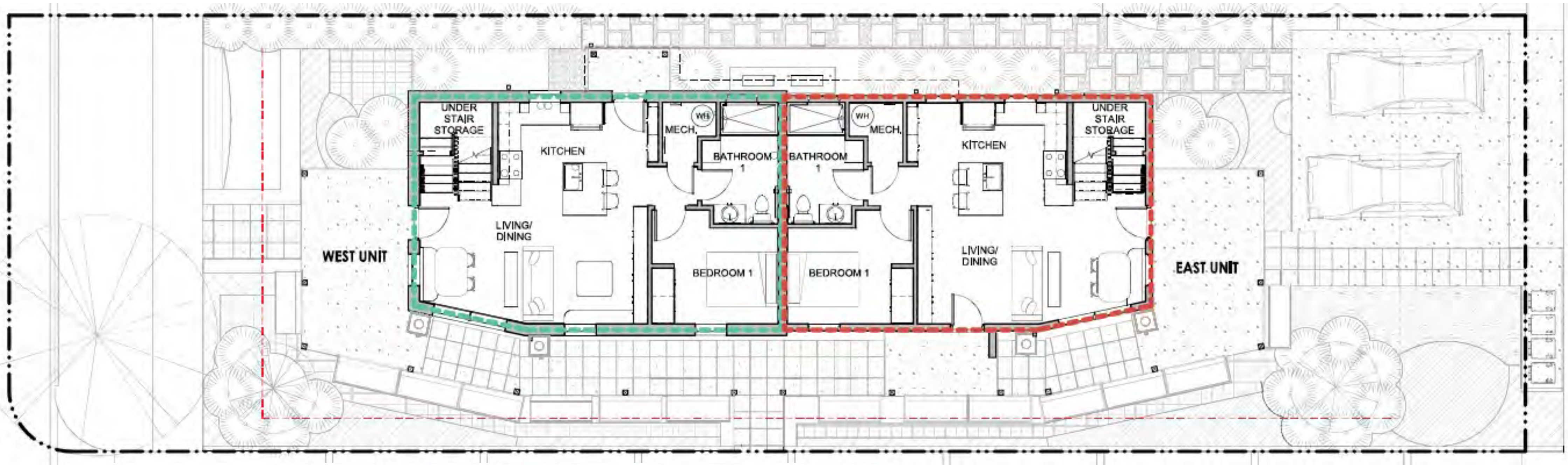
CREATING A SUSTAINABLE SITE & HIGH-PERFORMANCE BUILDING DESIGN

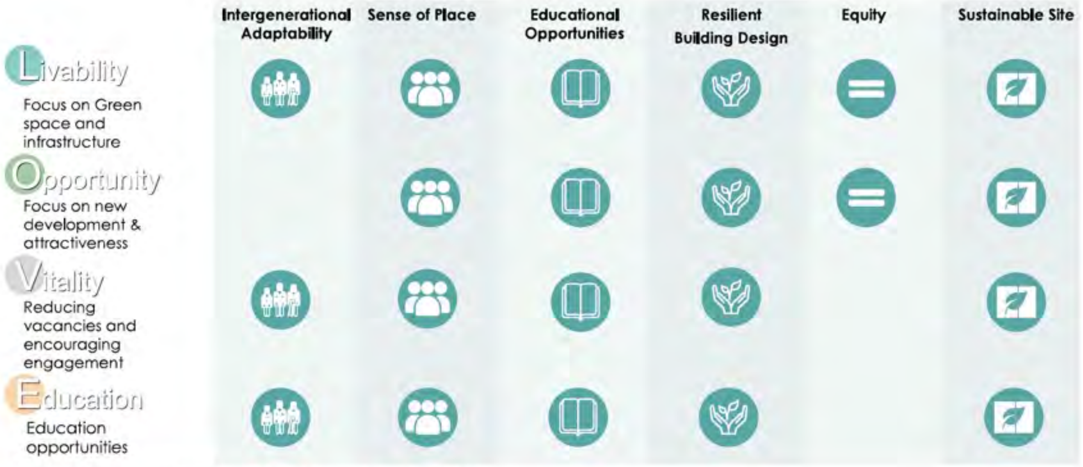
BUILDING RESILIENCE IN THE HOME

PROVIDING FOR INTERGENERATIONAL ADAPTABILITY + LIFE CYCLE CHANGE

FOSTERING EQUITY AND INCLUSION

Two Compact Units: 1350 sf East and West

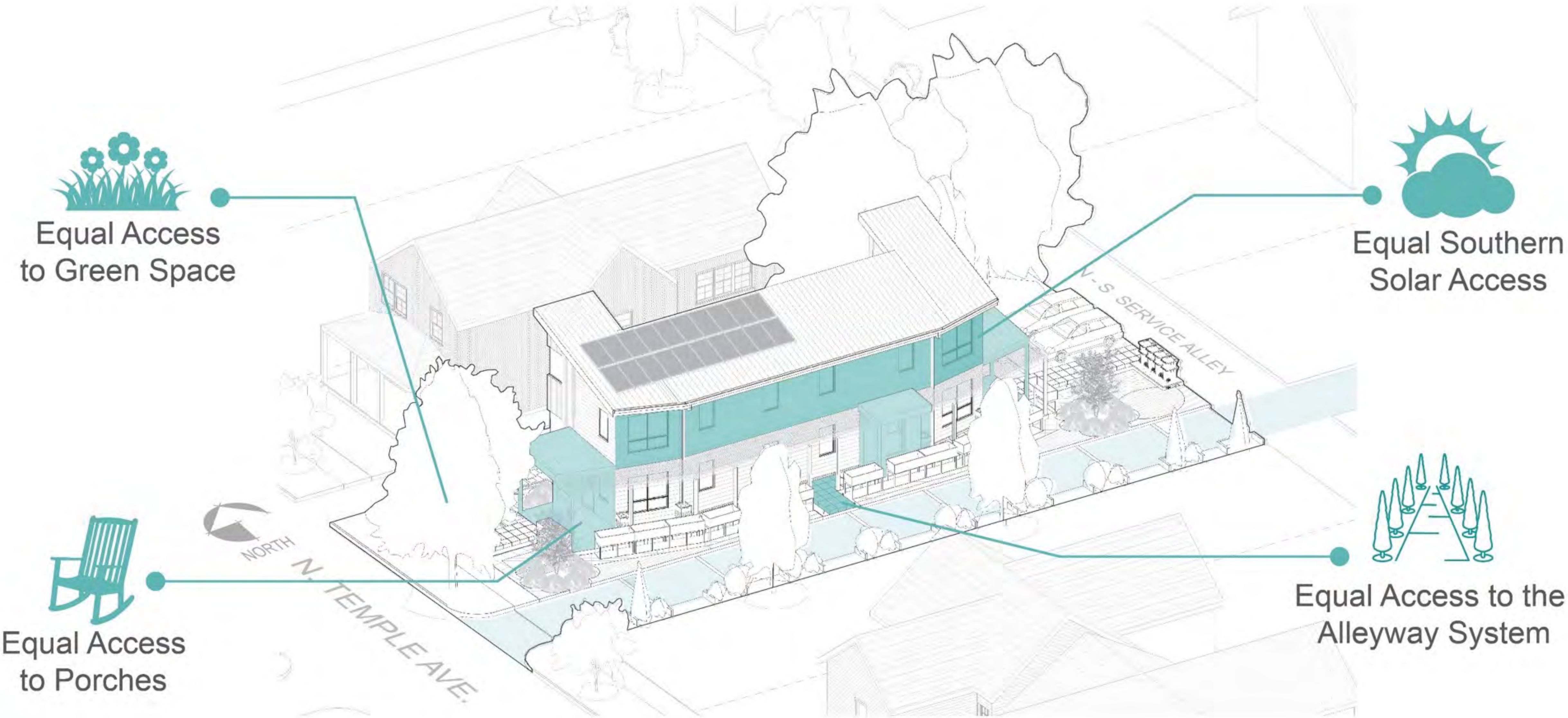




	Intergenerational Adaptability	Sense of Place	Educational Opportunities	Resilient Building Design	Equity	Sustainable Site
Livability Focus on Green space and infrastructure	●	●	●	●	●	●
Opportunity Focus on new development & attractiveness		●	●	●	●	●
Vitality Reducing vacancies and encouraging engagement	●	●	●	●		●
Education Education opportunities	●	●	●	●		●

Relationship of Project Goals and Englewood CDC Goals

Urban Duplex: Analysis & Design Equity



Equal Access to Green Space

Equal Southern Solar Access

Equal Access to Porches

Equal Access to the Alleyway System

Contextual & Ecosystem Design

Englewood is a compact context area with a strong sense of history combined with dedication to community development. Understanding this background and conveying the qualitative aspects of the area, students created graphics to illustrate the existing urban form, its building types, land uses, and relative scale, highlighting the unique elements of the area. They worked with landscape architecture students for sustainable strategies in water management and natural "green infrastructure" to support our regional ecosystem and help build habitats.

- Englewood Village Great Places 2020 Plan
- Infill Housing Guidelines for Compact Context
- Consider massing, height, architectural features
- Characteristic porch culture + shallow front yard
- Create alleyway as unique public greenspace
- Sustainable Sites framework for landscape
- Employ variety of water management strategies
- Promote gardening sustainable food production
- Landscape with low-maintenance native plants
- Provide bioswale + rain garden in SE corner

SITE INFORMATION

Address: 201 N Temple Ave.

Zoning: D5

Property Area: 5000 SF

Buildable Area: 2000 SF

Setbacks:
- Front - 13 FT
- Side - 3 FT
- Back - 10 FT

EAST-WEST ALLEY CONDITIONS

Property Vacancy

Lack of lighting

Varied Vertical Dimension

Poor Pedestrian/Bicycle Connectivity

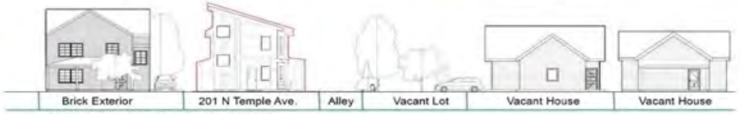
Lots Directly Across from Site

Poor Alley Conditions

Roadside Litter

Limited Vegetation

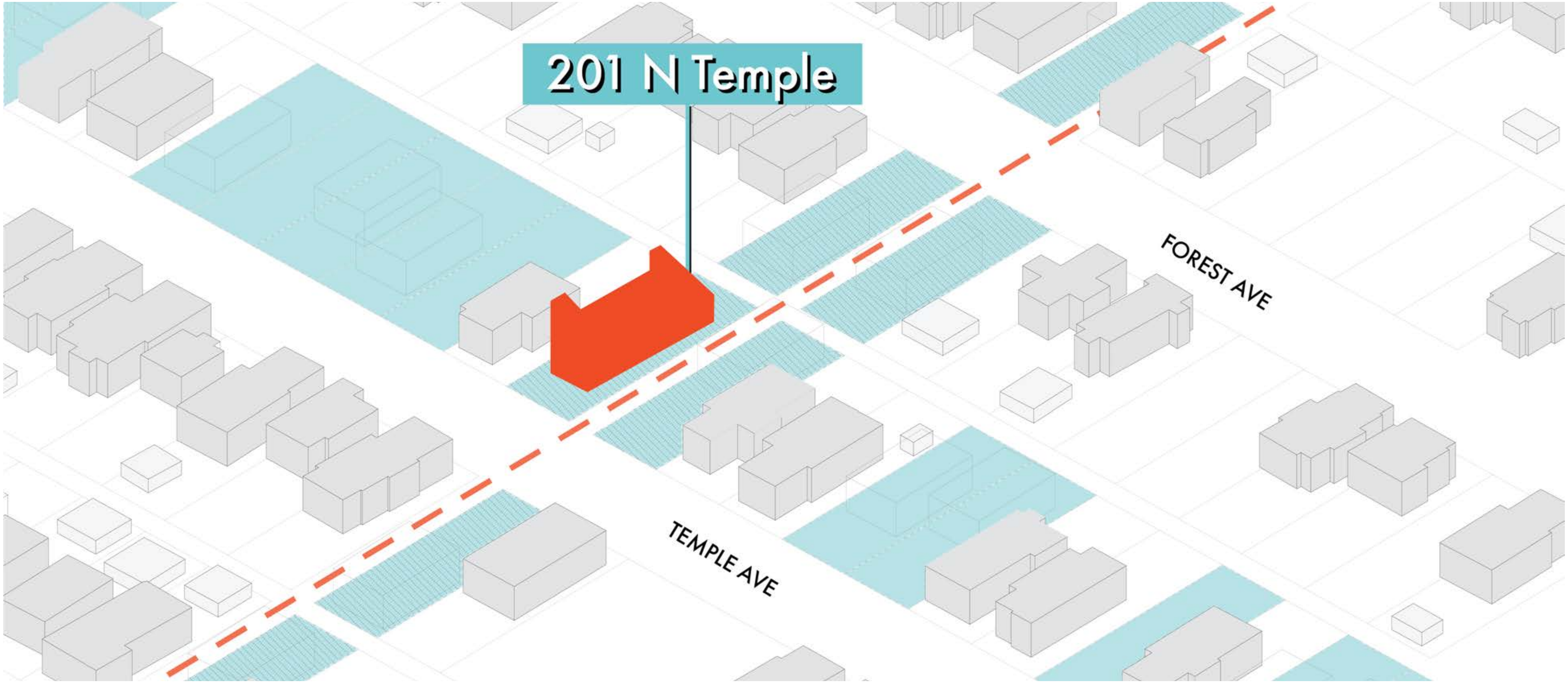
Privacy Fences



Immediate North & South Lots Surrounding site

Analysis of the alley and potential for a pedestrian natural habitat corridor

Contextual Design: Temple Street Facade

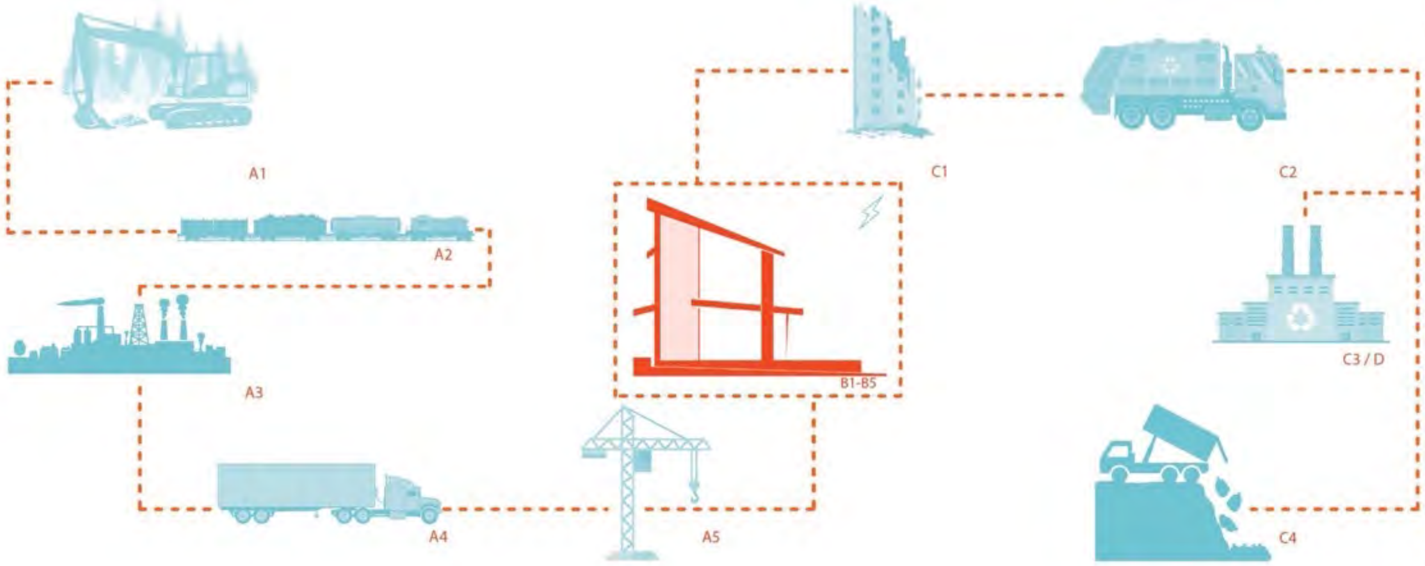

201 N Temple
FOREST AVE
TEMPLE AVE

Design For Economy

Affordability & Funding Sources

From day-one, the student team used the LIHTC requirements given to the owner/community partner to structure and inform the design approach and process in the design studio courses. Every decision was made regarding first/construction costs tied to the budget and long-term costs tied to operations and maintenance by the owner and cost of utilities and maintenance by the tenants.

- LIHTC funding as part of a larger scattered site housing project
- CDBG funding from the City of Indianapolis
- Grant funding from US DOE and State Farm Insurance
- Product donations and discounts
- Cost-saving student design and building activities
- Community partner will rent units at 30% or 50% AMI
- Tenants will be part of a rent-to-own program for up to 15 years



A1-A3 PRODUCT STAGE
A1 RAW MATERIAL EXTRACTION
A2 TRANSPORT TO MANUFACTURING SITE
A3 MANUFACTURING

A4-A5 TRANSPORTATION STAGE
A4 TRANSPORT TO CONSTRUCTION SITE
A5 INSTALLATION / ASSEMBLY

B1-B5 USE STAGE
B1 USE
B2 MAINTENANCE
B3 REPAIR
B4 REPLACEMENT
B5 REFURBISHMENT

C1-C4 END OF LIFE
C1 DECONSTRUCTION & DEMOLITION
C2 TRANSPORT
C3 WASTE PROCESSING
C4 DISPOSAL

D BEYOND THE BUILDING
D REUSE - RECOVERY - RECYCLING

Advanced Framing Construction

Passive Ventilation System Design

Local Materials

Photovoltaic Panel System

Native Landscaping and Water Collection and Retention

Super-Insulated Construction

Construction Costs Breakdown

New Construction Cost

Price/sq. ft.	$274.30
Total sq. ft. of Duplex	2,700
Construction Cost	$649,662.39
Construction Cost w/ Soft Costs	$740,615.03

Property Tax

Tax Rate	1.04%
Annual Property Tax	$2,047.06
Monthly Property Tax	$170.59

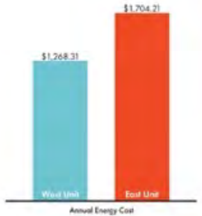
Financing

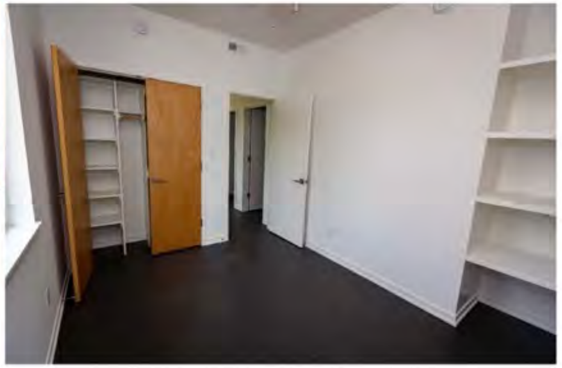
Interest Rate	2.86%
Years	30
Number of Payments	360
Down Payment (15% Dev.)	$ 106,050.00
Principal Amount	$600950.00
Monthly Payment	$1,669.97

Rent to Own Plan

15 Year Plan
Rent Based on Income
30% AMI - $474,000
50% AMI - $770,000
60% AMI - $894,000

Estimated Monthly Cost of Utilities	$200.00
Monthly Insurance	$200.00





Economic and Market Viability

NEAR EASTSIDE STATISTICS ACCORDING TO GREAT PLACES 2020 PLAN

- ■ Self Employees 10.6%
- ■ Private Companies 74.14%
- ■ Governmental Workers 7.51%
- ■ Not for Profit Companies 7.75%

- ■ Never Married 51.07%
- ■ Married 33.22%
- ■ Separated 2.35%
- ■ Widowed 3.62%
- □ Divorced 12.09%

- ■ Owner Occupied 41.45%
- ■ Renter Occupied 58.55%

- ■ No High School 8.18%
- ■ Some High School 52.38%
- ■ Some College 18.57%
- ■ Associate Degree 4.25%
- □ Bachelor's Degree 11.68%
- ■ Graduate Degree 4.95%

- ■ Households w/ Children 23.47%
- ■ Households w/out Children 76.53%

90% Adults prefer the idea of aging-in-place.

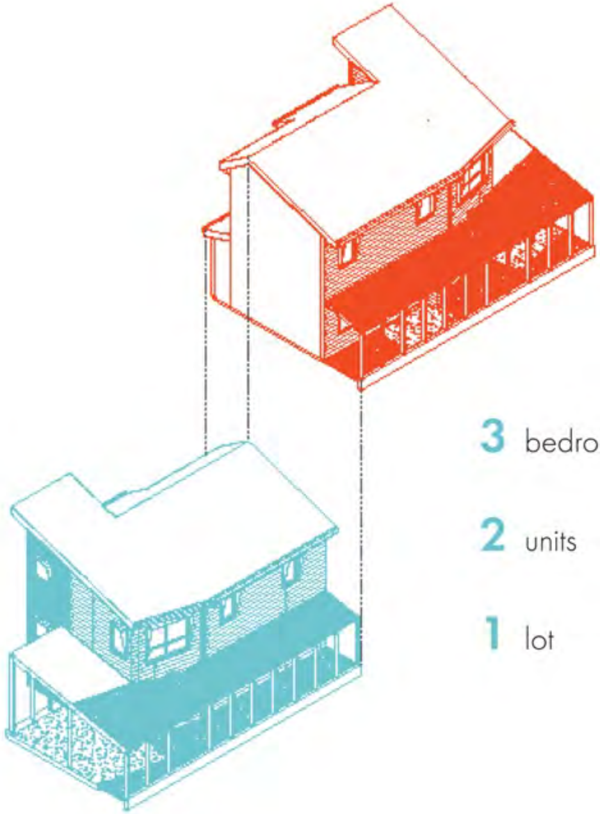
38% Job growth within the next 10 years in Indianapolis, Indiana.

12% Indianapolis' population are the age of 65 or older.

30% Indianapolis' population are the age of 18 or younger.

$23K Average annual income of a community member

Affordable Duplex on Alleyway Vacant Lots



3 bedrooms per unit

2 units

1 lot

🟥 Vacant Lot - Part of Englewood CDC's Infill Project

▨ Vacant Lot

🟦 Alley House Site

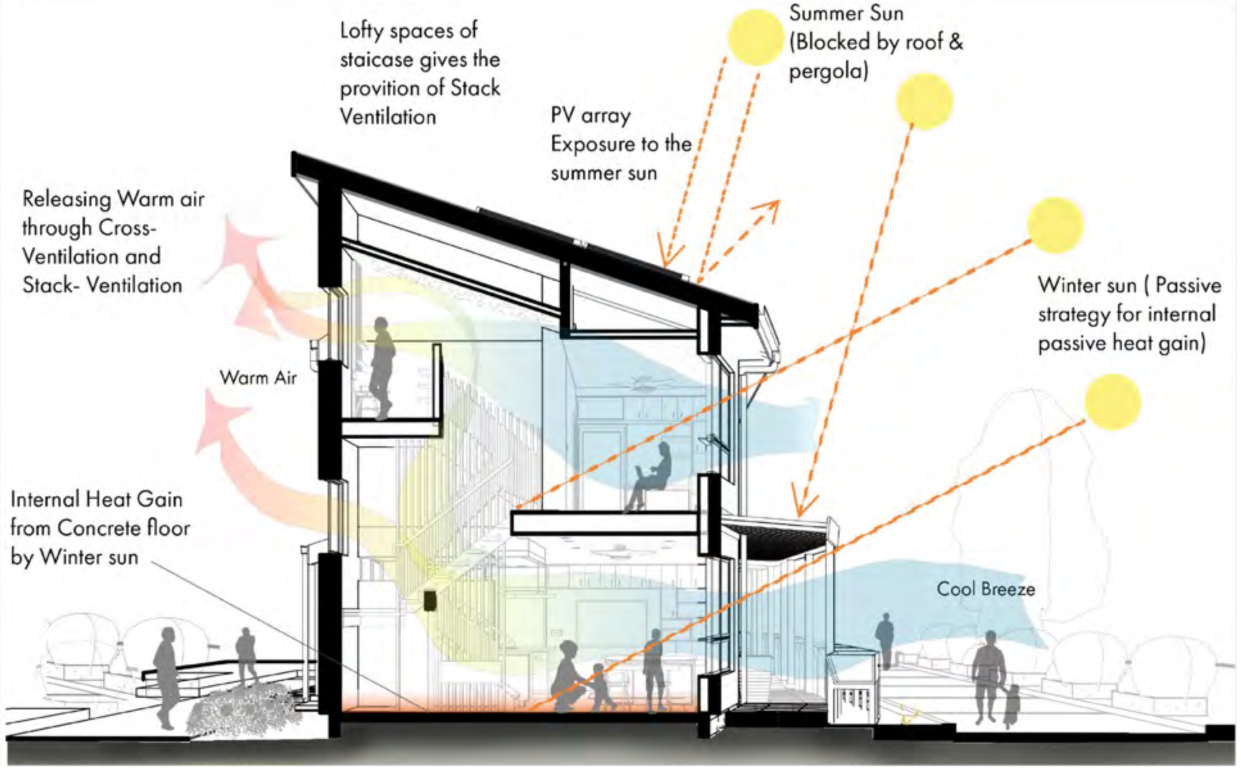
▨ East-West Alley

☐ Existing Buildings

☐ Roadways

▨ Lots

Passive Design Considerations Lower Costs



PASSIVE ELEMENTS

STAIR TOWER

INTERNAL HEAT GAIN

OPERABLE WINDOWS

- Envelope
- Passive Heating
- Passive Cooling
- Daylighting
- Storm Water Management

Rent to Own: Potential Tenants

Potential Occupants

FAMILY #3

This family is interested in renting the Alley House. Tina is the grandmother, living with her adult daughter and granddaughter in the neighborhood.

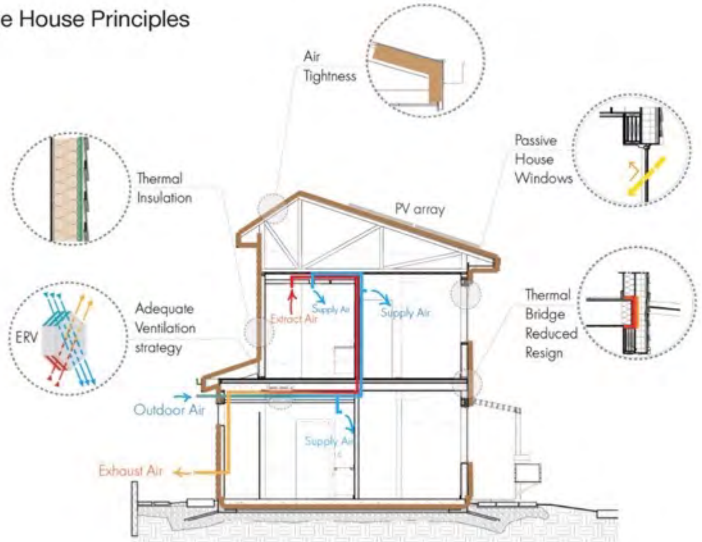
This is Kim. She has an adult son living with her who has physical disabilities. Here, she and her friend are discussing her family renting the house.

FAMILY #4

Rent to Own: The New Tenant Amber

Design For Environment

Passive House Principles



Health & Well-Being Design

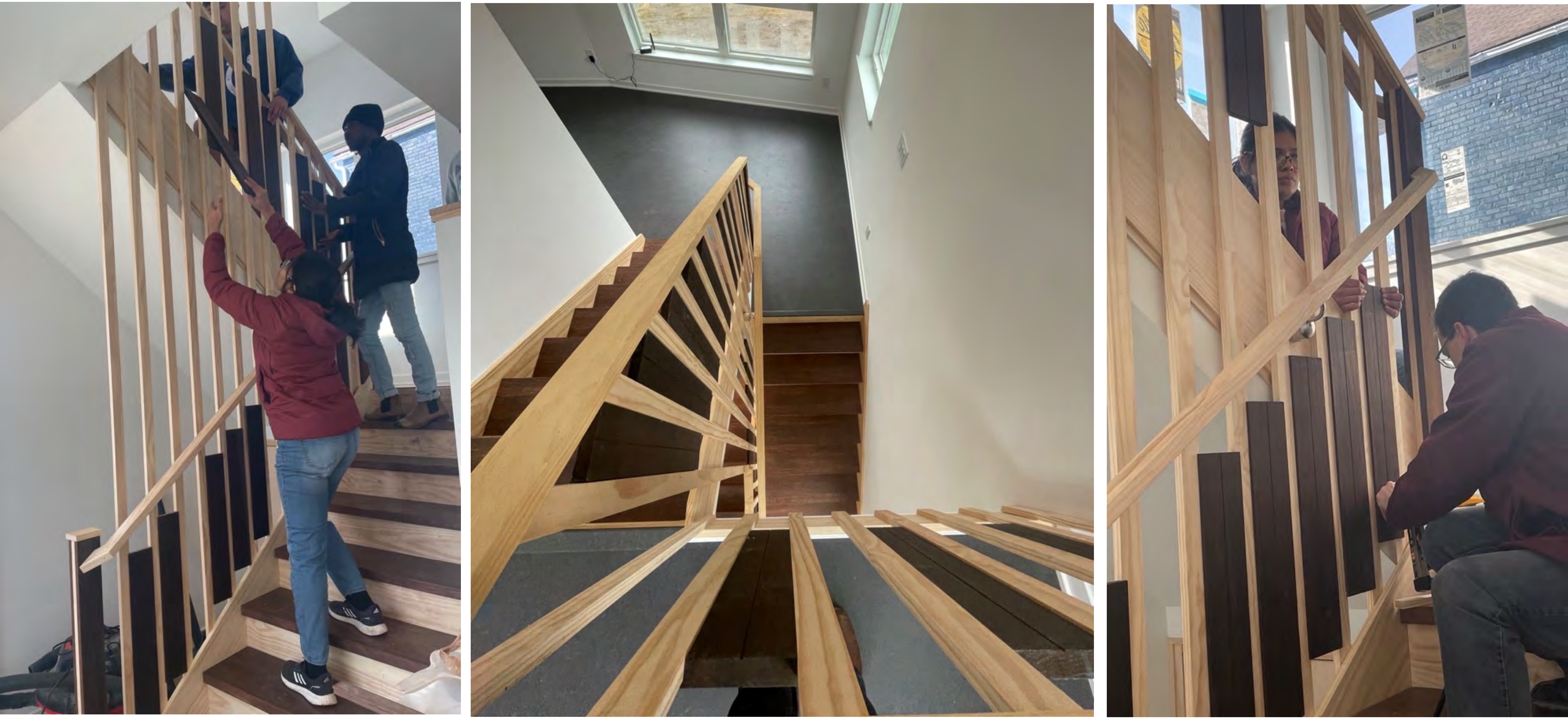
Biophilic design using natural materials and connecting the inside with the outside informs the project. Transitional spaces are reinforced in the duplex's porches connected to the sun shading pergola, planting beds and boxes, rain gardens, and a bioswale. We leveraged Phius principles to address occupant's health and comfort with continuous insulation, radiation control, airtight construction, balanced ventilation, and minimalized mechanical.

- Views to natural landscaping from gathering spaces
- Use of natural hardwoods in cabinetry/built ins/stairway
- Energy recovery ventilator provides constant fresh air
- Haven IAQ monitor measures particulates, VOCs, humidity
- Optimized windows with radiation control and shading pergola
- Airtight construction value of .66 ACH50 air change/hour
- Continuous insulation with 5 inches of mineral wool

Biophilic Design Promotes Health + Well Being

Hand-Craft in Natural Hardwoods

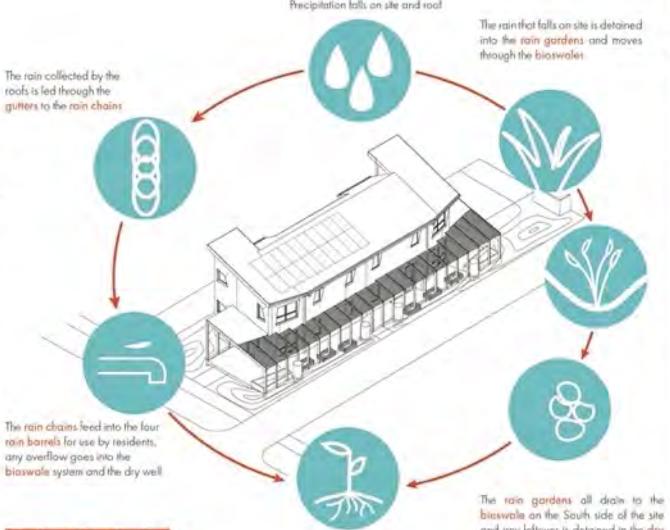
Stair Rail Construction



Design for Water

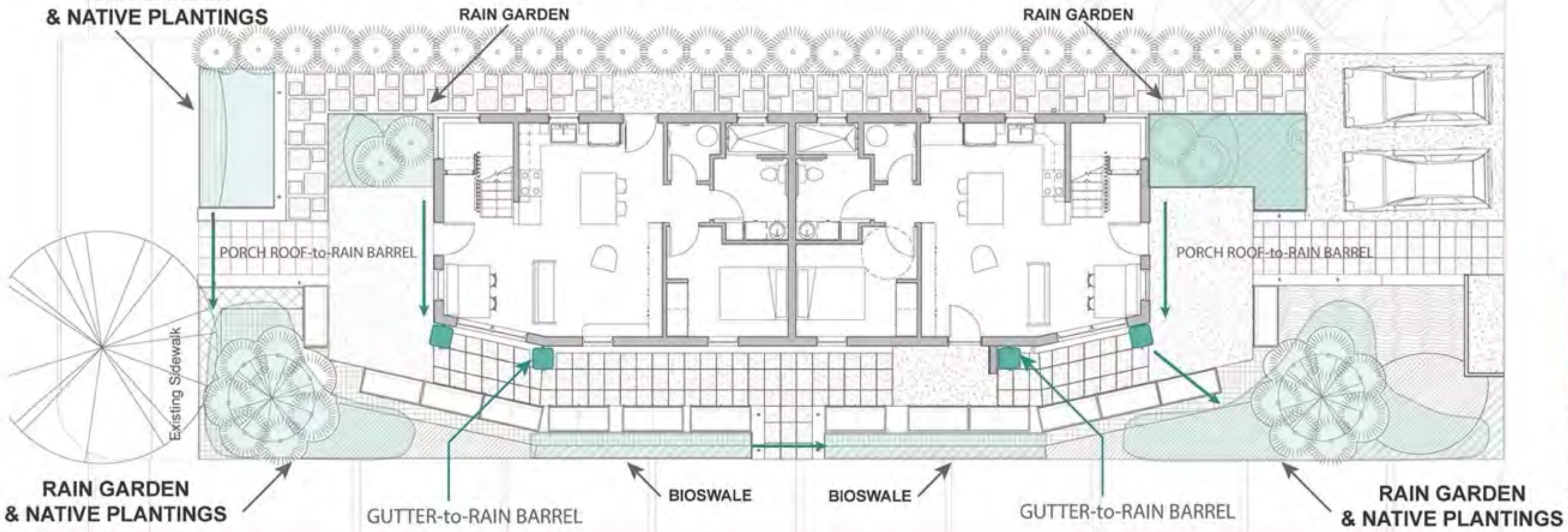
There is a lack of environmentally responsive and community conscious design in this neighborhood. The Alley House serves as a proof of concept not only through its impact on the community, but also with its building construction (following PHIUS prescriptive path), and landscape design (following Sustainable Sites certification), that the divide between sustainable building design practices and affordable housing criteria can be lessened. The Alley House designed for water carefully considering how all water could be harvested and used in rain gardens, bioswales, and for productive and flowering gardening. Two 100-gallon rain barrels are used on the south side and two more 80-gallon barrels on the north side of the Alley House. A large bioswale and rain garden in the southeast corner of the lot prevents water from draining to the alley, which every other house in the area does, creating a muddy mess. The Alley House designed the landscape utilizing Sustainable Sites as a framework, carefully calculating the rainfall and total volume of water to be managed in the vegetated space.

For domestic hot water we utilized a heat pump water heater because it is 2-3 times more efficient than a conventional electric resistance water heater. The water heater has a user interface module that allows real-time monitoring and control features such as hybrid or efficiency use and vacation time setback. The heat pump water heater will extract ambient heat from the interior of the home as part of the efficient vapor compression refrigeration cycle. It is also powered by the solar array and backup battery during weather emergencies. All the sink and lavatory faucets, water closets, and shower/tub faucets are low flow, water saving, and energy efficient.



On Site Water Cycling

Total Vegetated SqFt = **2,077.61 ft²**
Total Rain Barrel Capacity = **1,055 Gallons**
Water to Be Managed in Vegetated Space = **952.4 ft² or 7,142.2 Gallons**



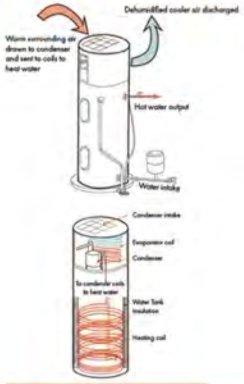
60th Percentil Event

0.34 in²

Total Unvegetated SqFt = **3,216 ft²** $\xrightarrow{(x12)}$ Total Unvegetated SqInches = **38,592 in²**

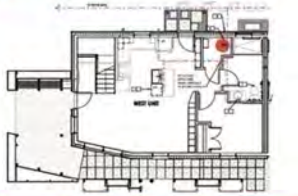
Total Rainfall on Unvegetated Surfaces = **13,121.28 in³** $\xrightarrow{(/12)}$ Total Rainfall on Unvegetated Surfaces = **1,093.4 ft²**

Total Gallons of Rainfall = 8,179.2



Water Heater Diagram

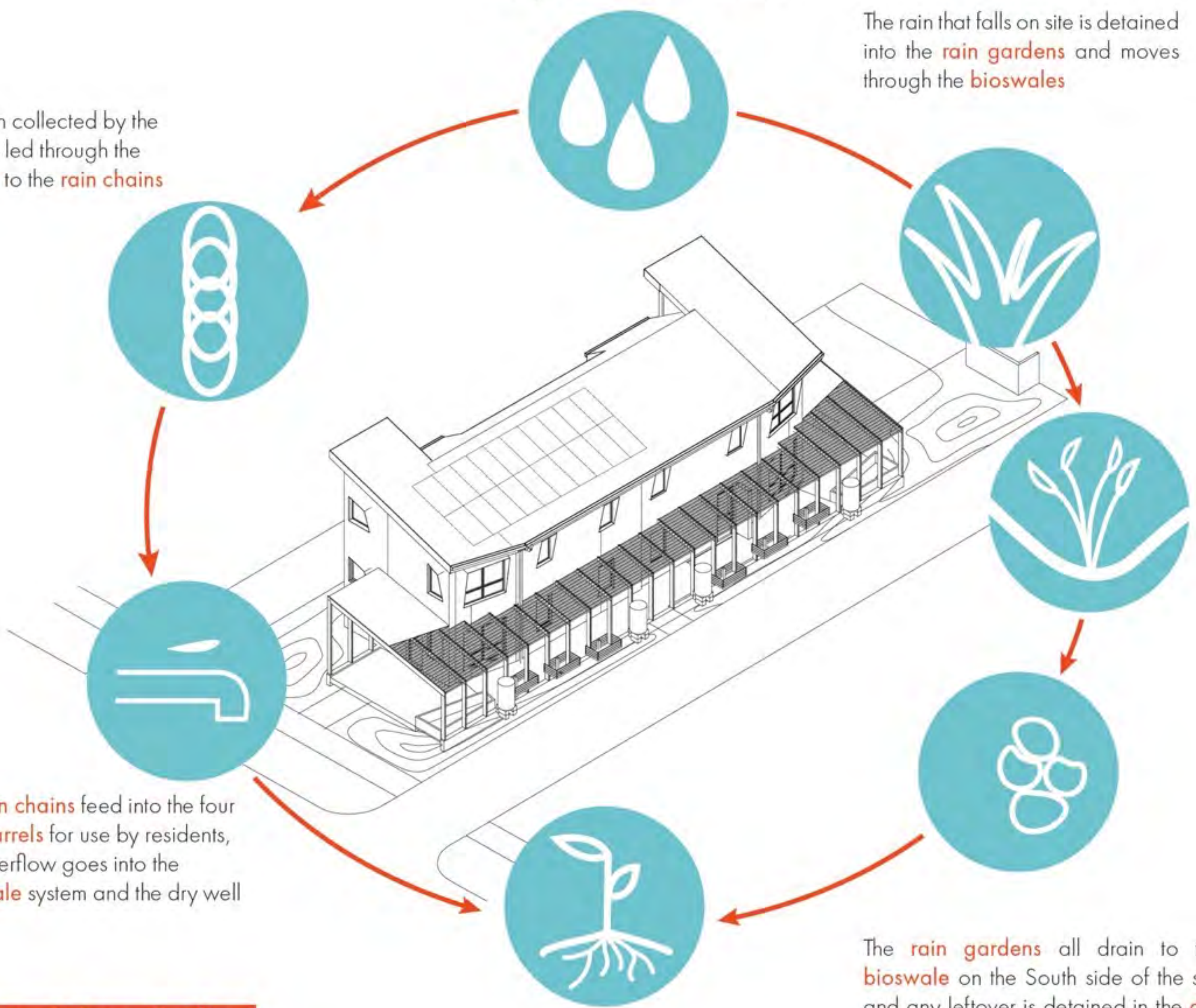
View of First Floor Mechanical Room



Location of Water Heater - West Unit First Floor

Collaboration with Landscape Architecture

Integrated Design Thinking



Precipitation falls on site and roof

The rain that falls on site is detained into the rain gardens and moves through the bioswales

The rain gardens all drain to the bioswale on the South side of the site and any leftover is detained in the dry well in the SE corner of the site.

The rain chains feed into the four rain barrels for use by residents, any overflow goes into the bioswale system and the dry well

The rain collected by the roofs is led through the gutters to the rain chains

On Site Water Cycling

Rain Garden & Bio Swale Construction

Design Build For Equity

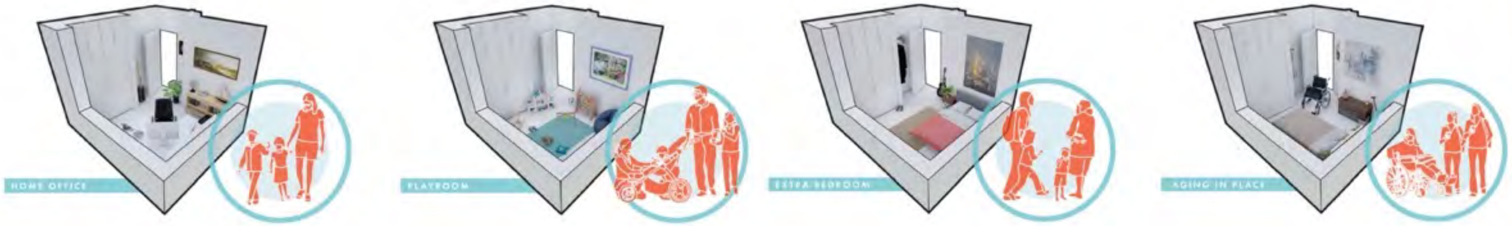
Adaptable & Flexible Design

The student team designed the Alley House as a two-family home that responds to the changing needs of a family life cycle. Flexible, multi-use, and accessible spaces with adaptable furnishings suit families with children, empty nesters, and elders who wish to age in place.

- Major living areas on 1st floor
- Ground floor bedroom
- Ground floor, ADA accessible full bathroom
- Zero-step entries
- Modular built-ins and moveable furnishings for storage and seating
- Flex space on the 2nd floor could be a playroom, office, or den
- Small footprint but a variety of spaces for occupants to get away

Second Floor Flex Space

First Floor Flex Space



3rd bedroom located on the ground floor can be used flexibly as – guest room, or in-law suite, or older youth, or aging in place

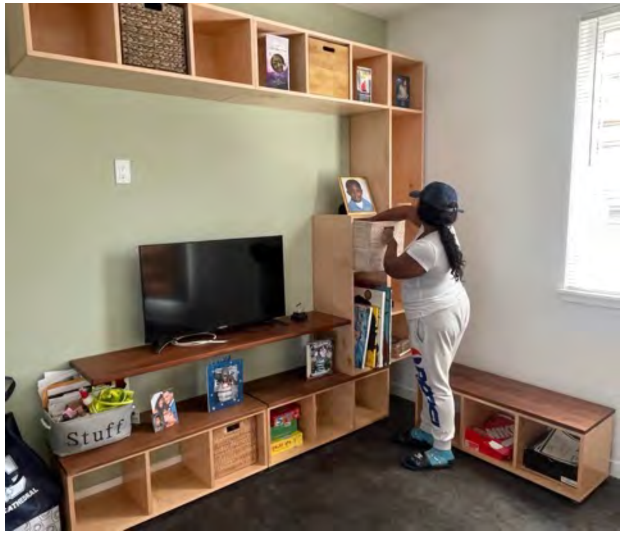
Family Centered Open Space Design

Major Gathering Areas on First Floor

Kitchen Cabinetry Construction & Installation

Media Wall & Study Space Installation

Family Centered Quality & Adaptability



ALLEY HOUSE CONSTRUCTION

Sustainability: Equity, Economy, Environment

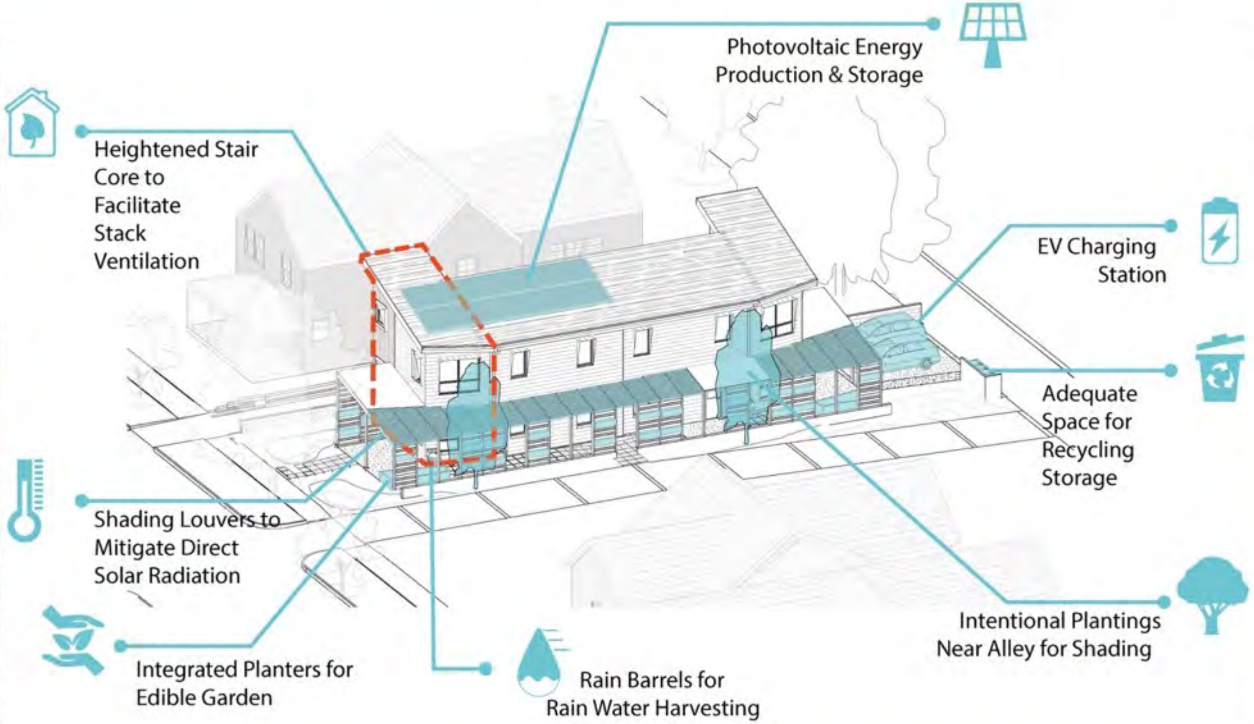
Build For Environment

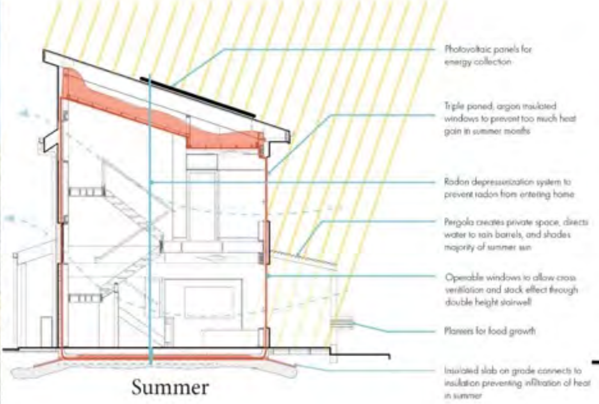
Integrated Design

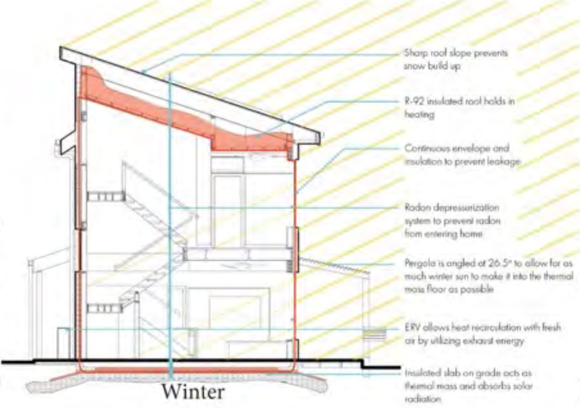
The Integrated Design Studios (ARCH 600+400) allowed student teams to develop the Alley House with focus on a layered consideration of systems integration guided by sixteen weekly assignments, topical presentations, participatory community engagement sessions, and design workshops.

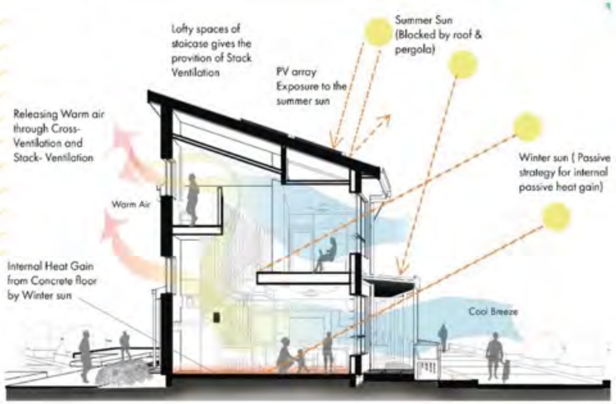
Site, context and neighborhood analysis, structural, environmental and building systems, accessibility and life safety, environmental stewardship, and technical documentation were all synthesized in the design build project. An integrated evaluation and decision-making process across all systems informed the process.

- PV array designed net-positive with battery back-up
- Rainwater harvesting in rain barrels and landscaping
- Stormwater retention bioswales and rain gardens
- South façade shading pergola protects summer sun/allows winter
- Frost-protected shallow foundation reduces concrete used
- Passive strategies of cross & stack ventilation and thermal mass
- Super-insulated building envelope









Frost Protected Shallow Foundation

Insulated Floating Slab

Frost protected shallow foundation (FPSF)

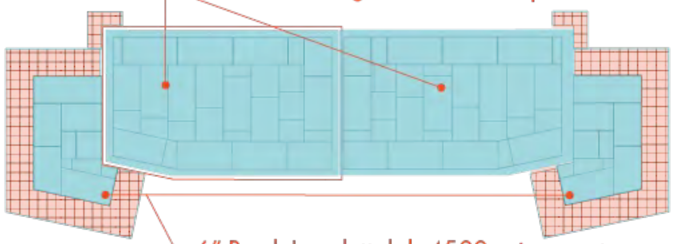
Facts:

- Does not use traditional concrete footers or stem walls
- Saves energy, time and construction cost by reducing material quantities, site preparation time, and slab construction
- 6″ of EPS foam beneath the slab sits on a compacted gravel base providing R-21.6 of insulation
- EPS slab edge form-work stays in place after concrete pour for thermal control

KEY

▨ Engineered insulation skirt (Type II + mesh)

🟦 Type II Sheets of rigid insulation



8″ Polished Legalett slab 3500 psi concrete

6″ Porch Legalett slab 4500 psi concrete

a] Exterior Mineral Wool Insulation

b] "J" Bolt Anchor

c] 1/2″ EPS Insulation

d] Earth Infill

e] Legalett Slab Edge

f] Blown-in Insulation

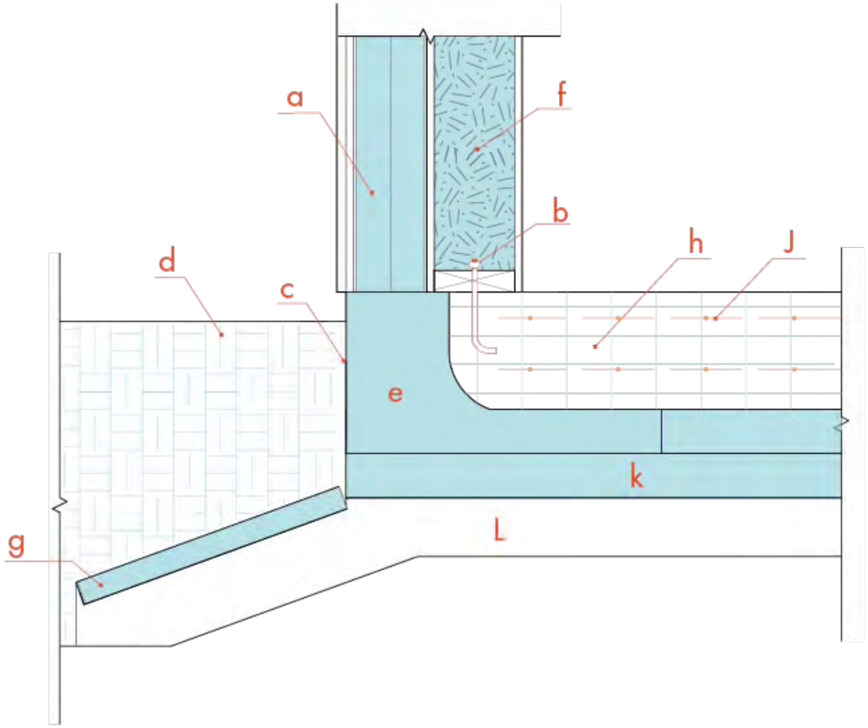
Rigid Insulation Skirt [g

8″ Concrete Slab (3500 psi) [h

#4 Rebar [J

Min. 6″ EPS Rigid Insulation [k

Compacted Gravel [L



Site Preparation

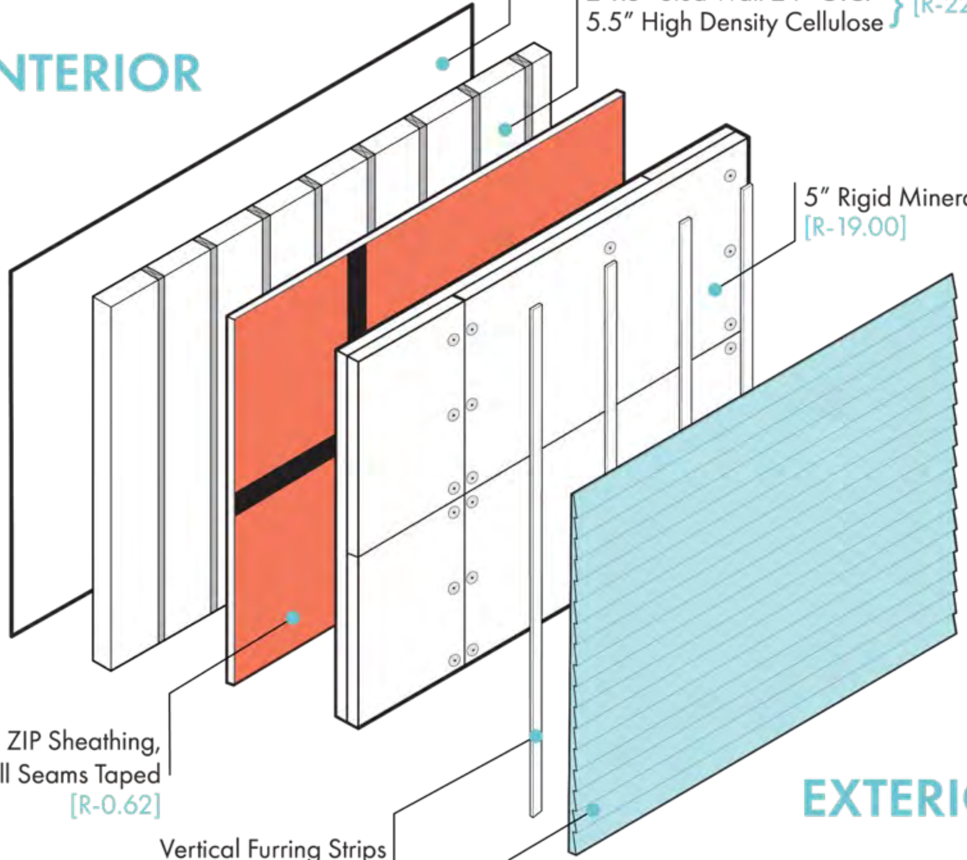
Compacted Gravel

Concrete Pour Over Rigid Insulation

Frost Protected Shallow Foundation

Sub-Contractor Innovation in Slab Pour

High Performance Enclosure System



Indoor Air Film / Finish Surface [R-0.68]
5/8″ Gypsum Sheathing [R-0.50]

2″x6″ Stud Wall 24″ O.C.
5.5″ High Density Cellulose } [R-22.00]

INTERIOR

5″ Rigid Mineral Wool Insulation
[R-19.00]

4′x8′ 7/16″ ZIP Sheathing,
All Seams Taped
[R-0.62]

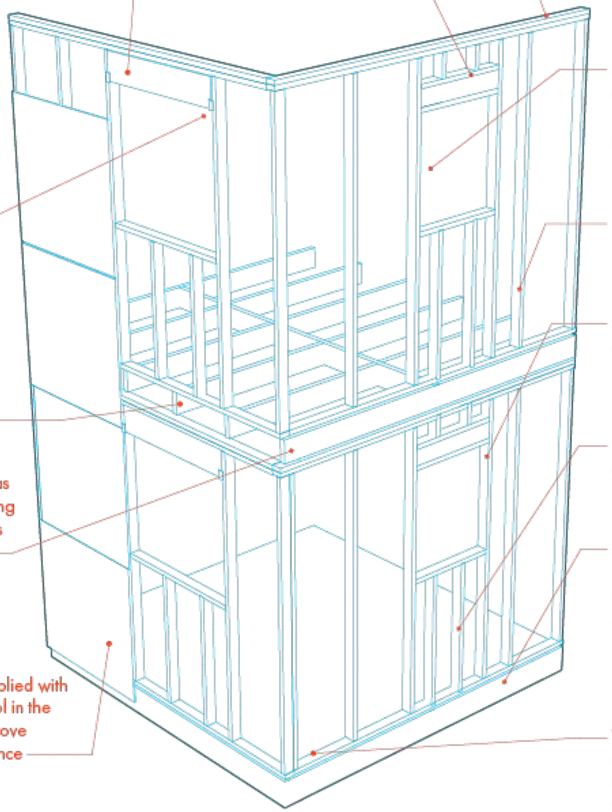
EXTERIOR

Vertical Furring Strips
[R-0.00]

Horizontal Fiber Cement Lap
Siding / Outside Air Film
[R-1.17]

Advanced Framing Construction

ADVANCED FRAMING FEATURES



Double top plate

Minimal Header, made of 2x6 studs to form a "C" shape where the cavity is on the interior + filled with typ foam board insulation

Properly sized headers with foam on interior

Header hangers eliminate jack studs

Stacked framing with TJI's transfer loads directly to studs below

The rim joists act as headers, transfering loads across studs below

ZIP sheathing, applied with 5" of mineral wool in the West Unit, to improve thermal performance

Place windows and doors on stud layout to minimize studs in jambs

2x6 studs at 24" O.C.

Single stud at rough openings due to stud alignment

No cripples under ends of window sills

Legallett concrete slab foam edge piece. Advanced framing on

Two stud corners will not compress insulation and reduce thermal bridging

Framing and Sheathing

Optimal Value Engineering + TJI Benefits

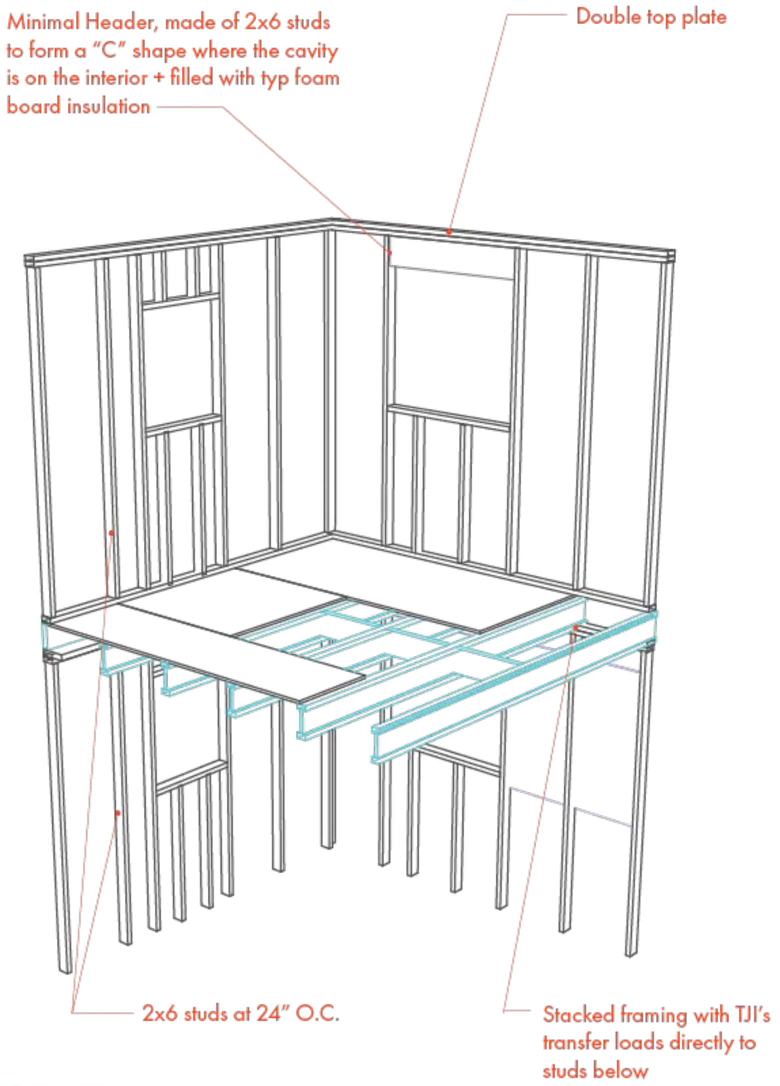
- Studs are generally spaced 24" on center instead of 16" saving lumber
- Framing method uses less wood in headers, sills, and jambs of windows and doors
- Framing method + 24" O.C. TJI selection allows for minimal wood in overall framing
- Less lumber to install = less labor cost + faster framing time
- Less lumber also decreases the heat loss from thermal bridging + more insulation

First Floor Framing

Advanced Framing with Zip Sheathing

Floor Framing Construction

TJI Floor Constuction



First Floor Framing

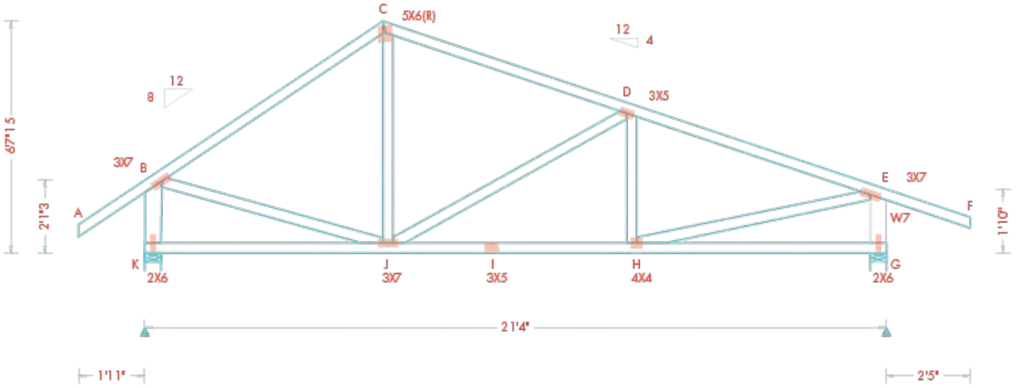
Truss Joist I-Joist (TJI)
Pre-manufactured wooden truss joist

Facts:

- TJIs directly align with the advanced framing wood studs bellow to carry the load
- TJIs enabled a long span with less depth eliminating interior baring walls
- TJIs consist of a top and bottom flangle of solid lumber held together with an oriented strand board (OSB) web and resembles a traditional wide-flange steel member
- TJIs use approximately 50% less wood than traditional joists and are pre-manufactured, resulting in high accuracy, consistency, and quality
- Made of engineered wood, they shrink less than traditional lumber and have greater resistance to twisting and warping

Engineered Roof Trusses

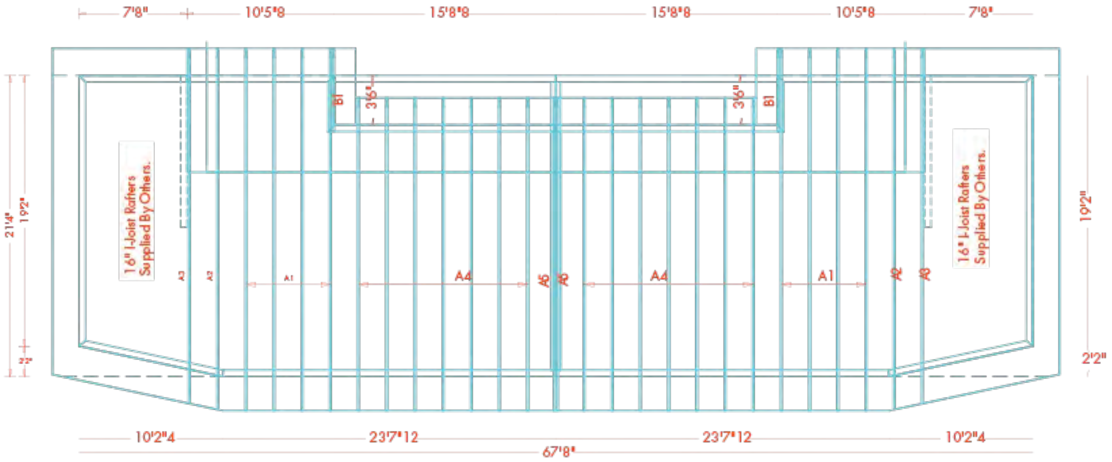
Roof Truss (A4)



Lumber:
Value Set: 13B (Effective 6/1/2013)
Top chord: 2x4 SP #1;
Bot chord: 2x4 SP #1;
Webs: 2x4 SP #3; W1,W7 2x6 SP #1;
Lumber value set "13B" uses design values approved 1/30/2013 by ALSC

Loading:
Truss designed for unbalanced snow loads.
Wind loads based on MWFRS with additional C&C
Truss designed for unbalanced snow loads.
End verticals not exposed to wind pressure.

Roof Truss Layout



Roof Framing

Roof Truss facts

- The south roof slope is 4:12 pitch, and the north slope is 8:12 pitch
- The trusses are spaced 24" on-center to align with the advanced wood stud framing below
- The roof slopes facilitate rainwater and snow melt runoff where gutters, downspouts, and rain barrels will collect it for irrigation use
- Asymmetrical gabled roof design also allows for the small mono-pitch section of the roof over the stair towers to work structurally and create more roof square footage on the south orientation to accommodate a larger solar PV array
- An innovative aspect of the Alley House's cold roof system (non-conditioned attic space) is the design of its control layers, which use taped sheathing at the 2nd floor ceiling."
- The floor of the attic is then filled with approximately 26" of loose-fill cellulose to achieve a thermal performance of R-92

Framing "Topping Off" Celebration

Window Selection: U factor and SHGC

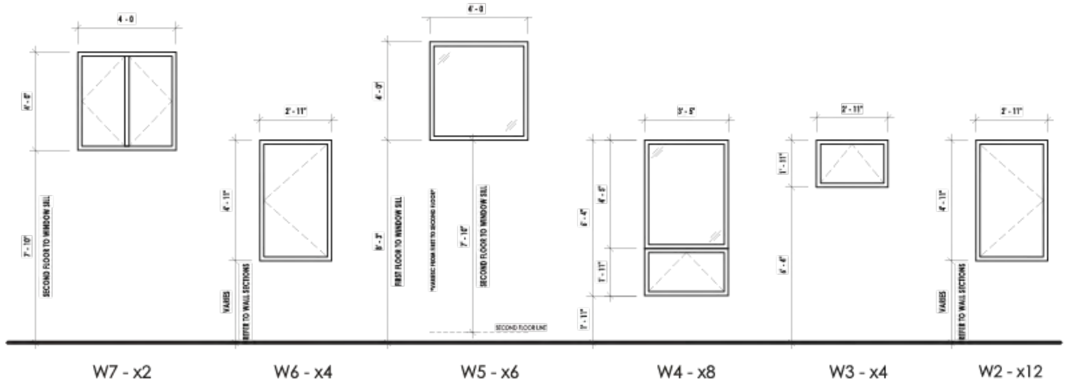
Window facts

- The window openings in the Alley House are strategically located as part of the 24" advanced framing module
- Pella triple-pane insulated glazing units (IGUs) in fiberglass frames filled with Krypton gas between glass panes and have low-e coating
- The windows will achieve the following energy performance ratings:
  - U-factor 0.16-18
  - Solar Heat Gain Coefficient (SHGC) 0.24 - 0.27
  - Visible Transmittance (Tvis) 0.43 - 0.50
- Energy Star-certified windows are 50% better than energy code compliant windows in Indiana and meet the PHIUS Core Prescriptive standards
- The windows are a combination of fixed, operable casements, and operable awnings
- Fiberglass was chosen for its strength, durability, and lower carbon footprint compared with vinyl frames and were lower cost and required less maintenance over time compared with metal clad wood frames

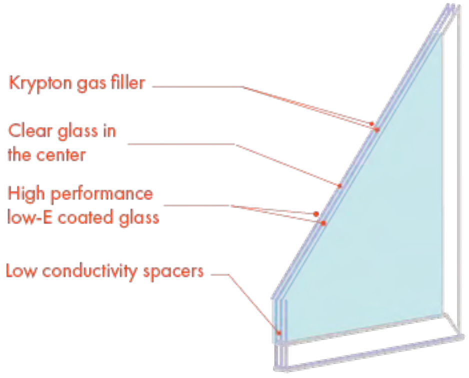

Window Operations


Window Installation


Window Aligned with ZIP Sheathing



Window Elevation



Triple Pane Window Section

Window Buck-out

Services: Good – Cheap - Fast

WE OFFER 3 KINDS OF SERVICES

GOOD · CHEAP · FAST

BUT YOU CAN PICK ONLY TWO

GOOD & CHEAP WON'T BE FAST

FAST & GOOD WON'T BE CHEAP

CHEAP & FAST WON'T BE GOOD

Ven Diagram: Good Cheap Fast

Cement Shortage - Infrastructure

Insulation Installation

Students helping with cellulose installation

Interior – 2 x 6 advanced framing wall cavities filled with Greenfiber Sanctuary dense packed blown-in cellulose

Installation of two layers of Rockwool

Exterior – taped layer of ZIP sheathing and 2 layers of Rockwool mineral wool continuous insulation 5" total

Cladding installation

Exterior – furring strips installed for cladding, allowing moisture to escape

Alley House Elevations


West Elevation


South Elevation

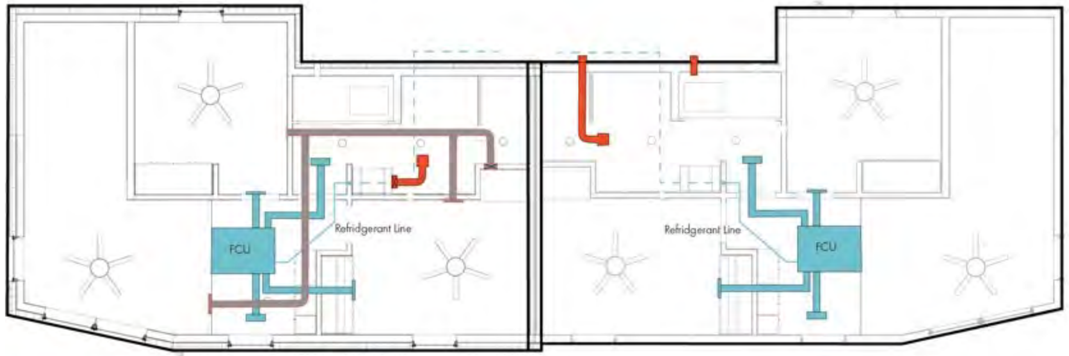

North Elevation


East Elevation

Alley House Elevations: Built

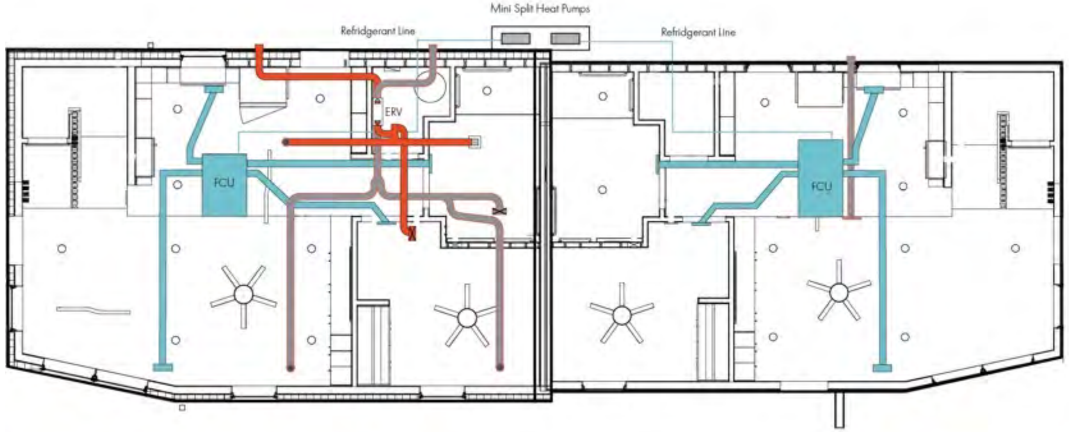
Mechanical System: Split System Heat Pump

FCU + ERV INTEGRATION PLANS



Second Floor

🟦 FCU System ◼ Fresh Air Supply 🟥 Exhuast Air



First Floor

🟦 FCU System ◼ Fresh Air Supply 🟥 Exhuast Air

Outdoor Heat Pump Install

First Floor FCU in framing

Fan Coil Unit (FCU)

Mitsubishi multi-zone, short ducted heat pump system

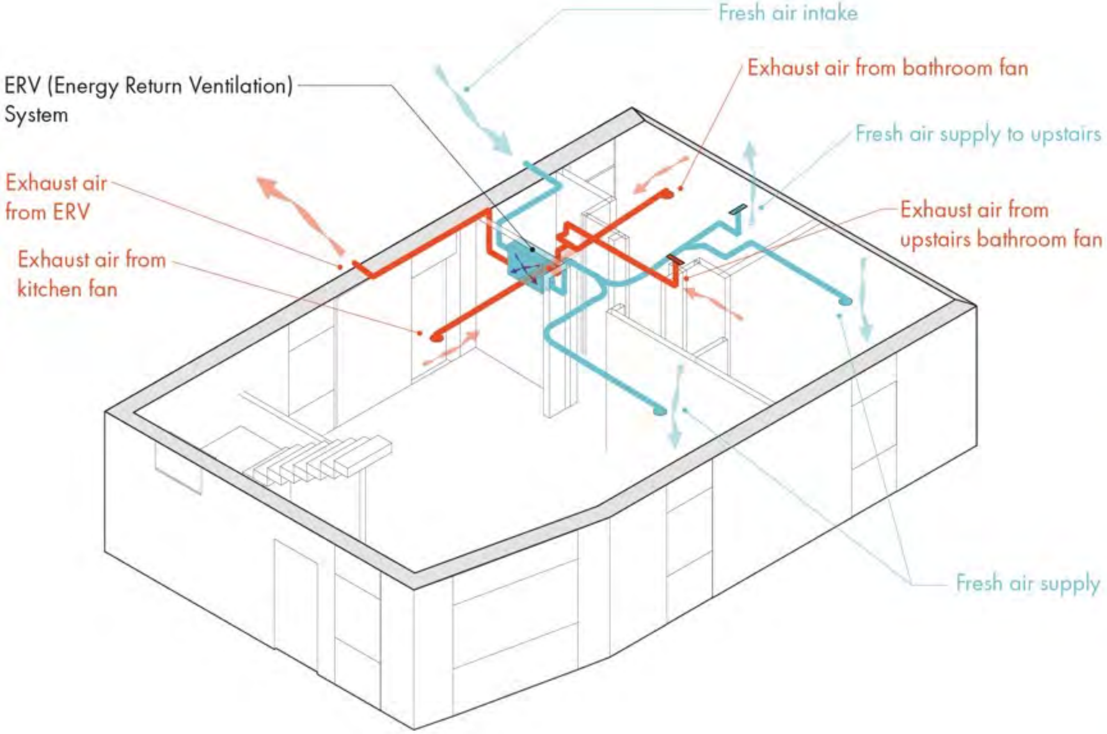
Facts:

- Split zoning of first and second floor allow for smaller mechanical units to be hidden in dropped ceiling saving mechanical room space
- Zone splitting allows for saving in energy usage by supplying heating or cooling where it is needed
- Integrating an ERV with the FCU provides fresh preconditioned outside air throughout the home
- Performance characteristics of the system:

SEER	17.3
EER	13
HSPF	9.8
COP Heating (47F)	3.10
COP Cooling	4.82
Indoor Acoustics	23-30 dB (A)

Ventilation System: Energy Recovery Ventilator

ERV INTEGRATION



ERV Second Floor chases

ERV in mechanical room

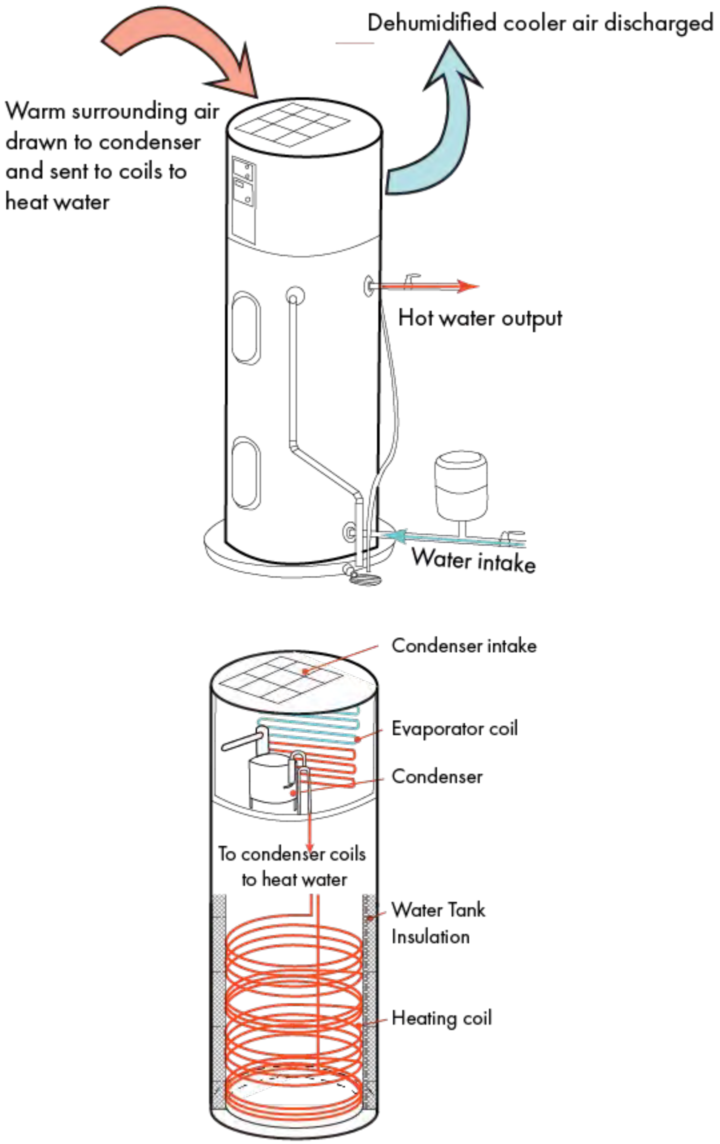
Energy Recovery Ventilation (ERV)

Greenheck Sync 180 energy recovery ventilator

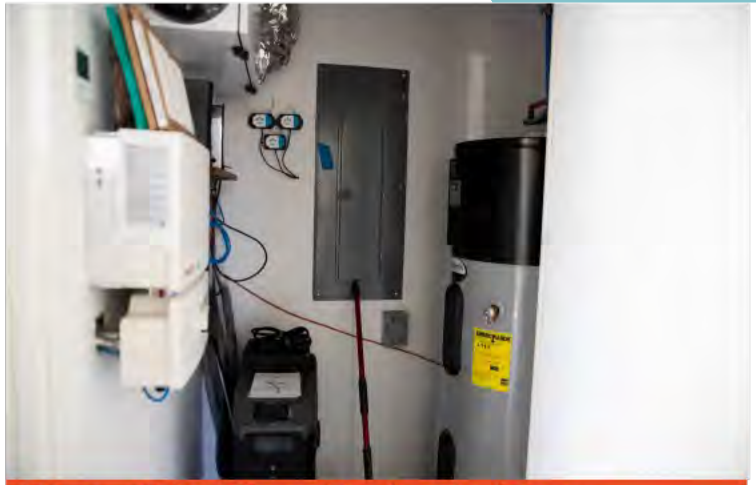
Facts:

- The ERV, fitted with a MERV-13 filter, supplies air to "clean" spaces such the living area, bedrooms, and flex space via 6" hard ductwork.
- Contaminated air is pulled from the kitchen and bathrooms continuously. Bathrooms are fitted with a boost mode switch to temporarily increase the air flow rate (supply and exhaust) after a high-moisture event like a shower
- Fresh, dehumidified air supplied via the ERV is then used by the multi-zone heating/cooling system, which does not supply any fresh outside air. The ERV has a sensible recovery efficiency of 84%.
- Exhaust and supply air streams do not cross but run through a heat and moisture exchanger for energy recovery.
- Meets ASHRAE 62.2 standards

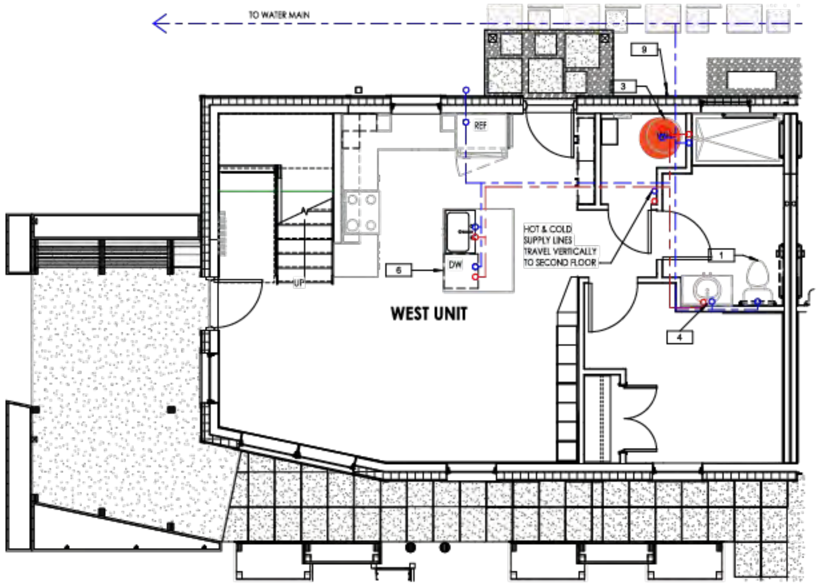
Hot Water System: Heat Pump Water Heater



Water Heater Diagram



View of First Floor Mechanical Room



Location of Water Heater - West Unit First Floor

Heat Pump Water Heater

- Heat pump water heaters are 2-3 times more efficient than conventional electric resistance hot water heaters
- A.O. Smith water heater includes a user interface module (UIM) that allows real-time monitoring and control features such as vacation setbacks
- This heat pump water heater will extract ambient heat from the interior air in the home as part of the efficient vapor compression refrigeration cycle
- The tank also has 4" of insulation to prevent heat loss from the tank to the interior

PLUMBING SYMBOLS

— — —	COLD WATER SUPPLY LINE
——	HOT WATER SUPPLY LINE
——	WASTE LINE
° - - -	VENT PIPE
⊥	HOSE BIB
●	Water Heater

Finished Installation: First Floor

PV Array Electrical System

Installed Solar Array

PV Panel Array & Storage - Mechanical Room

Solar Array facts

- The Alley House provides onsite renewable energy generation via an 8.8kW solar photovoltaic (PV) system composed to 22 Panasonic Evervolt 400w PV modules mounted on a rack to the south facing roof
- Helioscope software suggest that the array can provide 12,181 kWh of renewable energy per year. With a 25-year warranty their expected module yield at the end of the warranty period of 92%
- The PV array collects energy in the form of direct current (DC). The energy then is moved through an inverter in the mechanical room to become the alternating current (AC) used by the appliances, outlets, and other equipment in the home
- The electrical system connects to an outdoor electric vehicle (EV) charging station for use by occupants with an electric vehicle
- Two Ecoflow modular, portable batteries can be charged during the daytime when occupants are using less solar energy and used in the event of a power failure or for load shedding

Alley House Performance

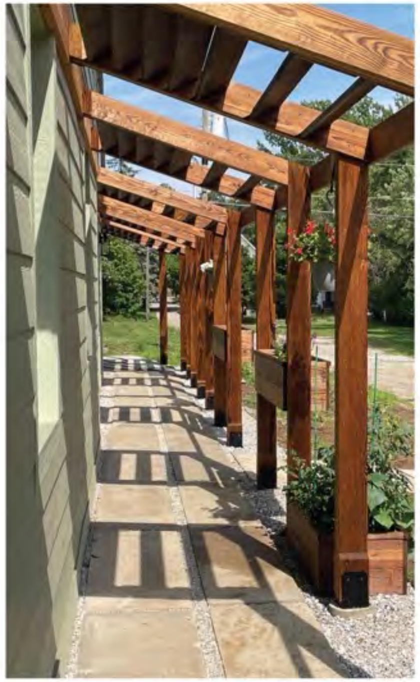
Sustainable Materials & Embodied Energy Design

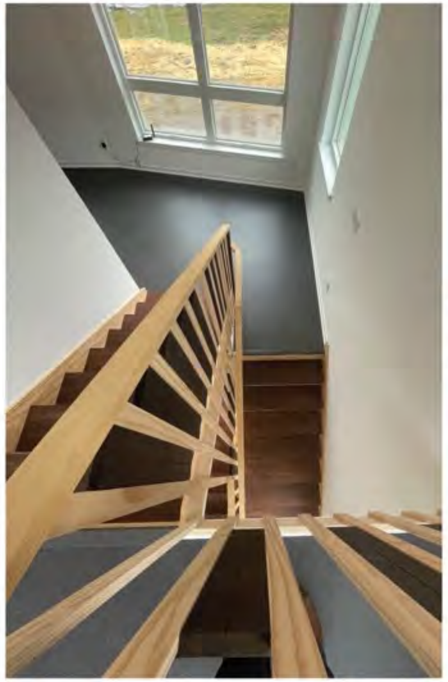
Informed material selection was critical in our design process, selecting sustainable, durable, safe, and healthy materials using Tally to consider Global Warming Potential. We chose a shallow frost protected slab using 33% less concrete, celebrated local materials with Indiana made thermally modified wood and Kentucky hemp wood, and used reclaimed walnut for the built-ins and reclaimed limestone from an IPS school for the pathway around Alley House. Wood fiber cellulose was used for wall cavities and cold roof because of its performance and ability to sequester carbon.

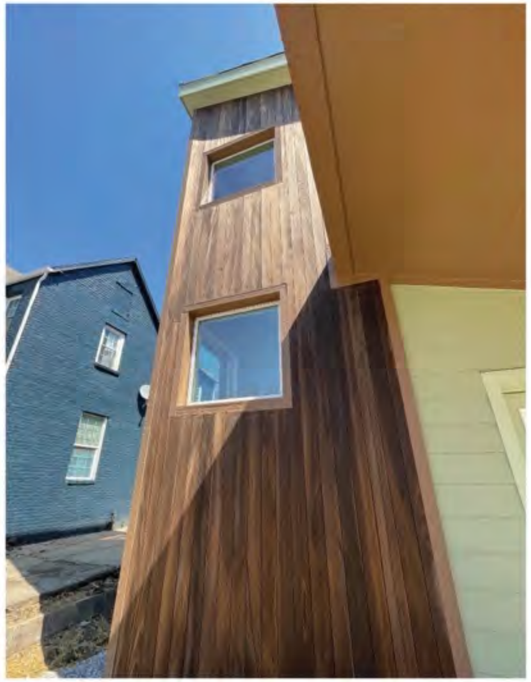
- Frost-protected concrete slab with R22
- Building envelope advanced framing + CI for R47
- Cold roof with wood fiber insulation R92
- Thermally modified wood stair tower cladding
- Wood fiber cellulose insulation -.3kgCO2e/m2
- Reclaimed and recycled wood and limestone
- Fiber cement cladding used for durability

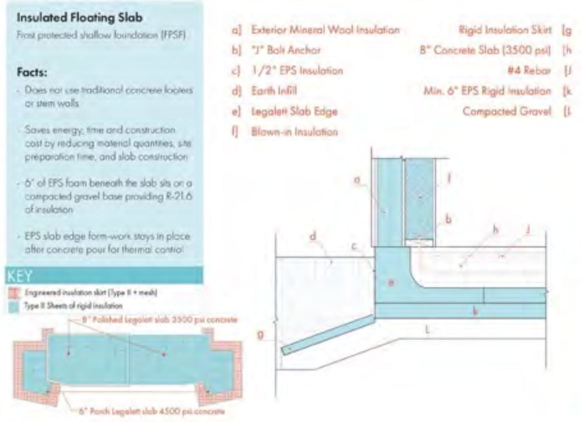
MATERIAL FINISHES

A: Thermally Modified Wood
B: Hemp Wood Flooring
C: Volcanic Ash Marmoleum
D: Birch Veneer Carbinets









Insulated Floating Slab

Frost protected shallow foundation (FPSF)

Facts:

- Does not use traditional concrete footers or stem walls
- Saves energy, time and construction cost by reducing material quantities, site preparation time, and slab construction
- 6" of EPS foam beneath the slab sits on a compacted gravel base providing R-21.6 of insulation
- EPS slab edge form-work stays in place after concrete pour for thermal control

KEY
▨ Engineered insulation skirt (Type II + mesh)
🟦 Type II Sheets of rigid insulation

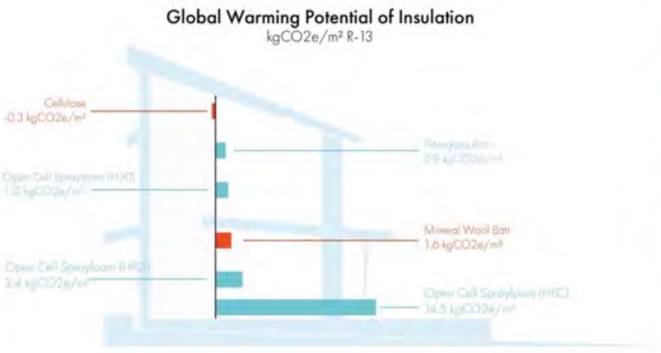
a] Exterior Mineral Wool Insulation
b] "J" Bolt Anchor
c] 1/2" EPS Insulation
d] Earth Infill
e] Legalett Slab Edge
f] Blown-in Insulation
Rigid Insulation Skirt [g
8" Concrete Slab (3500 psi) [h
#4 Rebar [J
Min. 6" EPS Rigid Insulation [k
Compacted Gravel [L


Site Preparation


Compacted Gravel

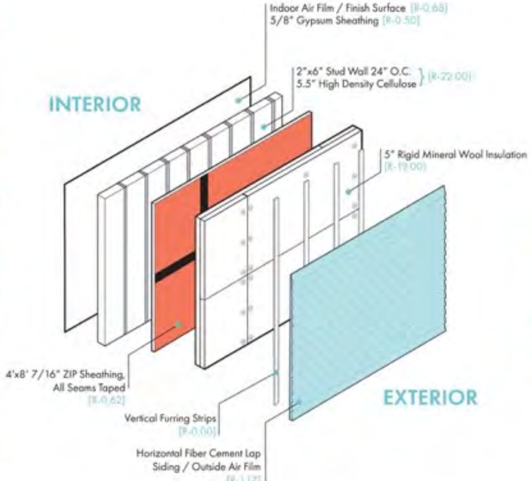

Concrete Pour Over Rigid Insulation

INSULATION GWP

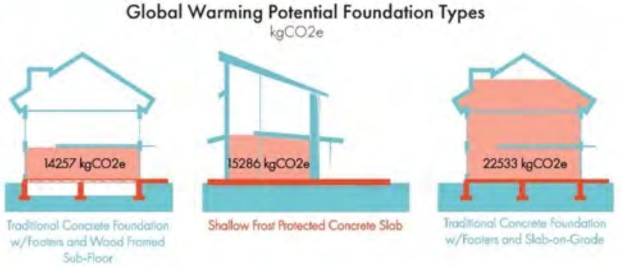



MINERAL WOOL INSULATION


CELLULOSE INSULATION



FOUNDATION GWP




EPS INSULATION INSTALLATION


CONCRETE POUR


COMPLETED SLAB

Affordability & Sustainable Materials

A: Thermally Modified Wood
B: Hemp Wood Flooring
C: Volcanic Ash Marmoleum
D: Birch Veneer Carbinets

Build For Economy

Collaboration with Partners

Students, faculty advisors, partners, community members, industry reps, and contractors and sub-contractors together are tackling the question, how can we take sustainable building design practices and technology and bridge the gap to meet affordable housing criteria for Englewood? Collaboration with the community and our partners provided immense opportunities for students to apply new and innovative techniques in the design and build and to challenge the status quo on high-performance building in Indiana. We celebrated each victory from ground breaking, to tree "topping off," to ribbon cutting ceremony with our partners!

Affordability & Industry Partnerships

Cedar Street Builders

Dan Porzel, Manager

Cedar Street Builders focuses on building high quality, high performance homes. Dan Porzel acts as a general contractor and consults with the team on high performance Cedar Street Builders will be building the home.

KP Meiring

Kemper Meiring

KP Meiring offers development, design-build, pre-construction, and construction services. KP Meiring is working with Englewood CDC on the other homes being constructed and is working with Cedar Street Builders on the Alley House.

Jefferson Electric

Joel Walsman, PV Consultant

Jefferson Electric is a fast-growing small business in Indianapolis that has provided donated consultation time to assist the team in solar array calculations, product selection and will potentially aid in the installation of the solar array to the unit. Jefferson provided a discount on the solar array and is providing us with a smart electrical panel box.

Greenheck

Tony Rossi

Greenheck has consulted the team in our system requirements for comfort and environmental quality. The company is also graciously donating an ERV.

McComb Window Company

Paul Spacco, Sales Rep. &
Angelo A. Zarvas, VP of Arch.Sales

McComb is a distributor for Pella. Pella Corporate gave us a big discount on the windows. McComb helped us choose the windows to meet the design specs--specifically the PHIUS certification requirements.

Nu-wool

Paul Spacco, Sales Rep. &
Angelo A. Zarvas, VP of Arch.Sales

McComb is a distributor for Pella. Pella Corporate gave us a big discount on the windows. McComb helped us choose the windows to meet the design specs--specifically the PHIUS certification requirements.

Thermafiber Owens Corning

Todd Shear, US Manager
Eric Aubrey, Indiana Sales Manager

Thermafiber is a potential provider of insulation material. The team is currently in discussion with the company.

Legalett Frost Proof Foundation

Ken Williams, VP of Sales
Mike Reynolds, Operations Director

Legalett have been contracted to provide the slab system and have provided a discount on the engineering services necessary to get the foundation through city permitting. The slab is called a frost-protected shallow foundation and Legalett is a proprietary system for this kind of foundation.

Mitsubishi

Mark Giganti, Sales

Mitsubishi is a potential provider of components of the HVAC system. The team is currently in discussion with the company.

Rock Wool

Nolan Szalmasagi, Territory Manager Indiana

Rock Wool is a potential provider of insulation material. The team is currently in discussion with the company.

Irving Materials Concrete

Trent Shannon, Sales

Thermafiber is a potential provider of insulation material. The team is currently in discussion with the company.

Green Fiber Cellulose

Rob Walker, Regional Manager

The team is currently in discussion with the company and they have tentatively said they would supply cellulose material.

Industry Partners & Products On Site

EcoVantage Wood

Rockwool Mineral Wool

Greenfiber Cellulose

AeroBarrier

Greenheck ERV`

Pella Windows

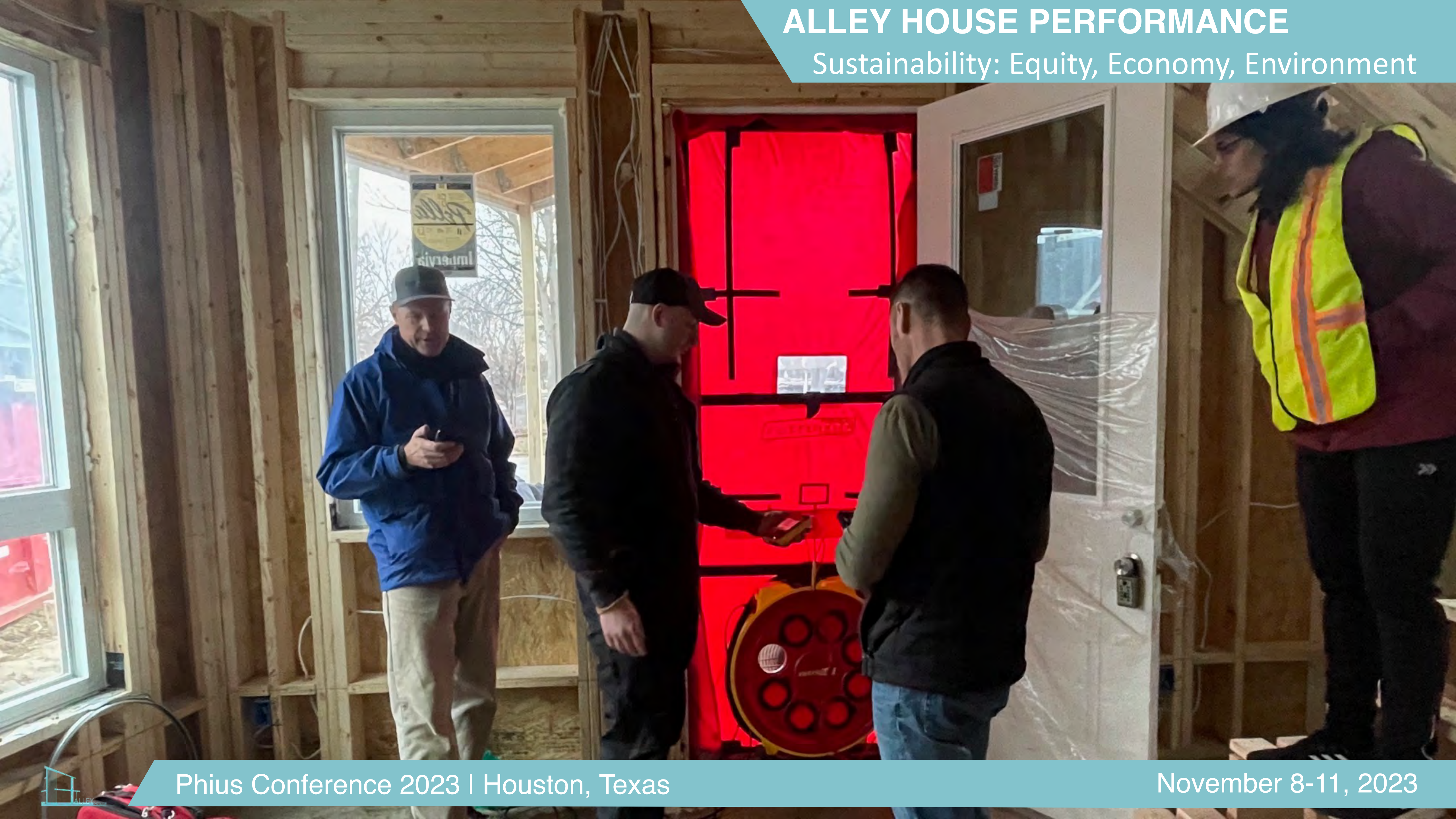
Jefferson Electric Solar

Quartz Countertops

Mitsubishi Heat Pump

ALLEY HOUSE PERFORMANCE

Sustainability: Equity, Economy, Environment



Measured Contest Areas Testing

Contest Structure

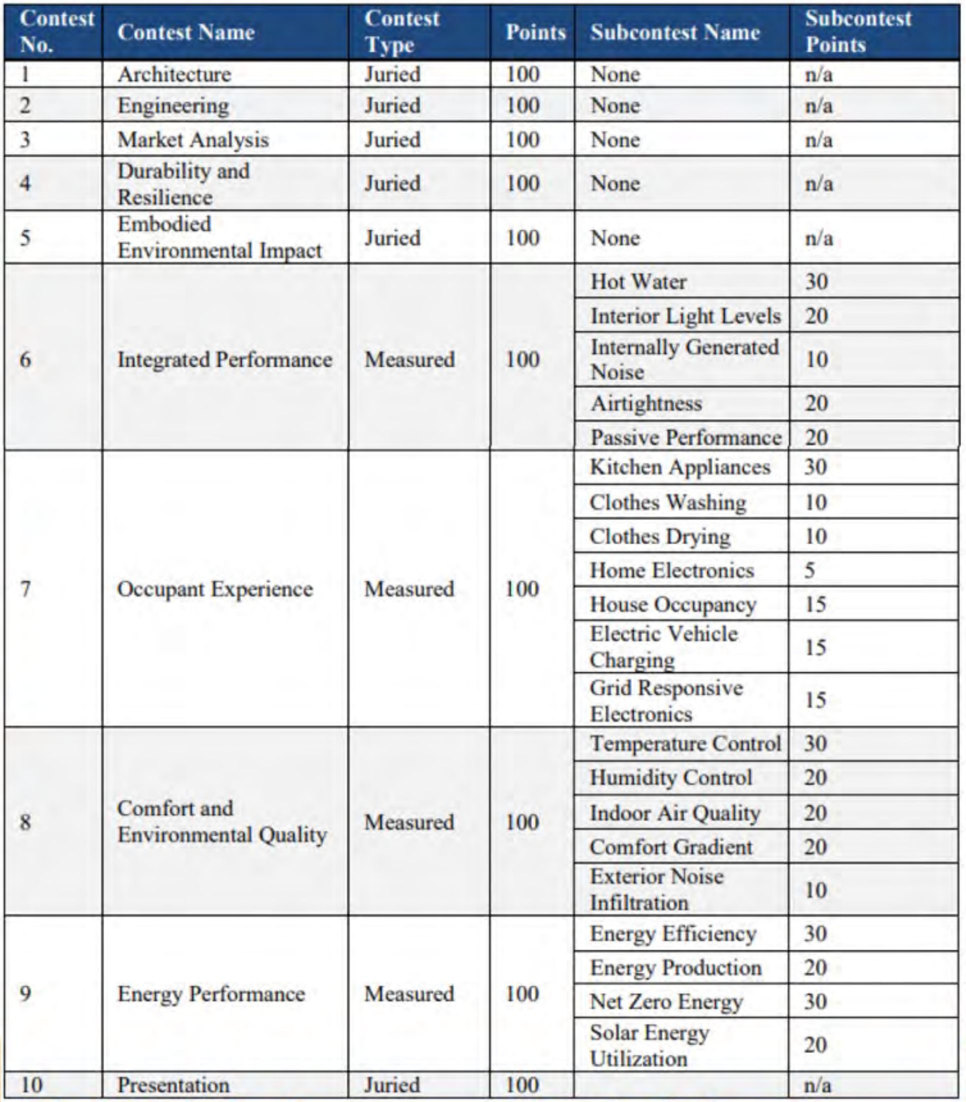
10 Total Contests

6 Juried (60% of total points)

4 Measured (40% of total points)

Highest final score out of 1,000 points wins

Teams must do well across all contests to win!



Contest No.	Contest Name	Contest Type	Points	Subcontest Name	Subcontest Points
1	Architecture	Juried	100	None	n/a
2	Engineering	Juried	100	None	n/a
3	Market Analysis	Juried	100	None	n/a
4	Durability and Resilience	Juried	100	None	n/a
5	Embodied Environmental Impact	Juried	100	None	n/a
6	Integrated Performance	Measured	100	Hot Water	30
				Interior Light Levels	20
				Internally Generated Noise	10
				Airtightness	20
				Passive Performance	20
7	Occupant Experience	Measured	100	Kitchen Appliances	30
				Clothes Washing	10
				Clothes Drying	10
				Home Electronics	5
				House Occupancy	15
				Electric Vehicle Charging	15
				Grid Responsive Electronics	15
8	Comfort and Environmental Quality	Measured	100	Temperature Control	30
				Humidity Control	20
				Indoor Air Quality	20
				Comfort Gradient	20
				Exterior Noise Infiltration	10
9	Energy Performance	Measured	100	Energy Efficiency	30
				Energy Production	20
				Net Zero Energy	30
				Solar Energy Utilization	20
10	Presentation	Juried	100		n/a

U.S. DEPARTMENT OF ENERGY
Solar Decathlon

2023
Build Challenge

Measured Contest Areas Testing

Instructions: Drag and drop each of the 9 measured contest events onto the calendar (the boxes are sized according to the number of days the event takes) and send back to the Organizers by March 15th, 2023 at sdbuild@nrel.gov . Below is some additional information and conditions to keep in mind when making your team's schedule:

- For contests that involve automated data collection (Continuous Monitoring Period, Interior Light Levels, Solar Energy Utilization, Passive Performance, Energy Production), the scored period will begin at midnight (local time zone) on the first day, and end at midnight on the last day outlined on your schedule. These contests may occur on weekends, as no Organizer presence is necessary.
- The EV charging event requires team members and Organizers to be present at the start and end of the 24-hour period. Neither the start nor end of this event may occur on a weekend.
- The Measured Contest Day may not occur on a weekend, as this involves Organizers to be present via Zoom.
- The Blower Door Test and HERS Rating likely cannot occur on a weekend, unless the third-party vendor allows. The Organizers will create an introduction for you to the vendor. It is not recommended to overlap this event with others, as it will take most of the day and could interfere with ongoing measurements. Teams must work with the vendor to determine a date for this event.
- The Net Zero Energy subcontest is not included in the schedule because it will be completed virtually by a third party.
- The Passive Performance subcontest cannot overlap with any other events.
- The House Occupancy subcontest must occur during the Continuous Monitoring Period.
- Besides the two conditions immediately above, all other contests can be overlapped in any way that teams decide.
- Starting March 20, teams will be subject to a 1 point penalty per day until any one of the 9 subcontests has started.
- Once a team submits their Measured Contest Schedule to the Organizer Team by March 15th, the schedule cannot be changed unless there are extenuating circumstances, as determined by the Organizers.
- **Please submit this powerpoint to the Organizers by March 15th, 2023**, and include the local time zone for your team's house in the email. The Organizers will check your team's schedule and approve it within 24 hours of the submission as long as it follows the above guidelines.

Continuous Monitoring Period 5 Days

Interior Light Levels 3 Days

House Occupancy 1 Day

Energy Production 1 Day

Solar Energy Utilization 3 Days

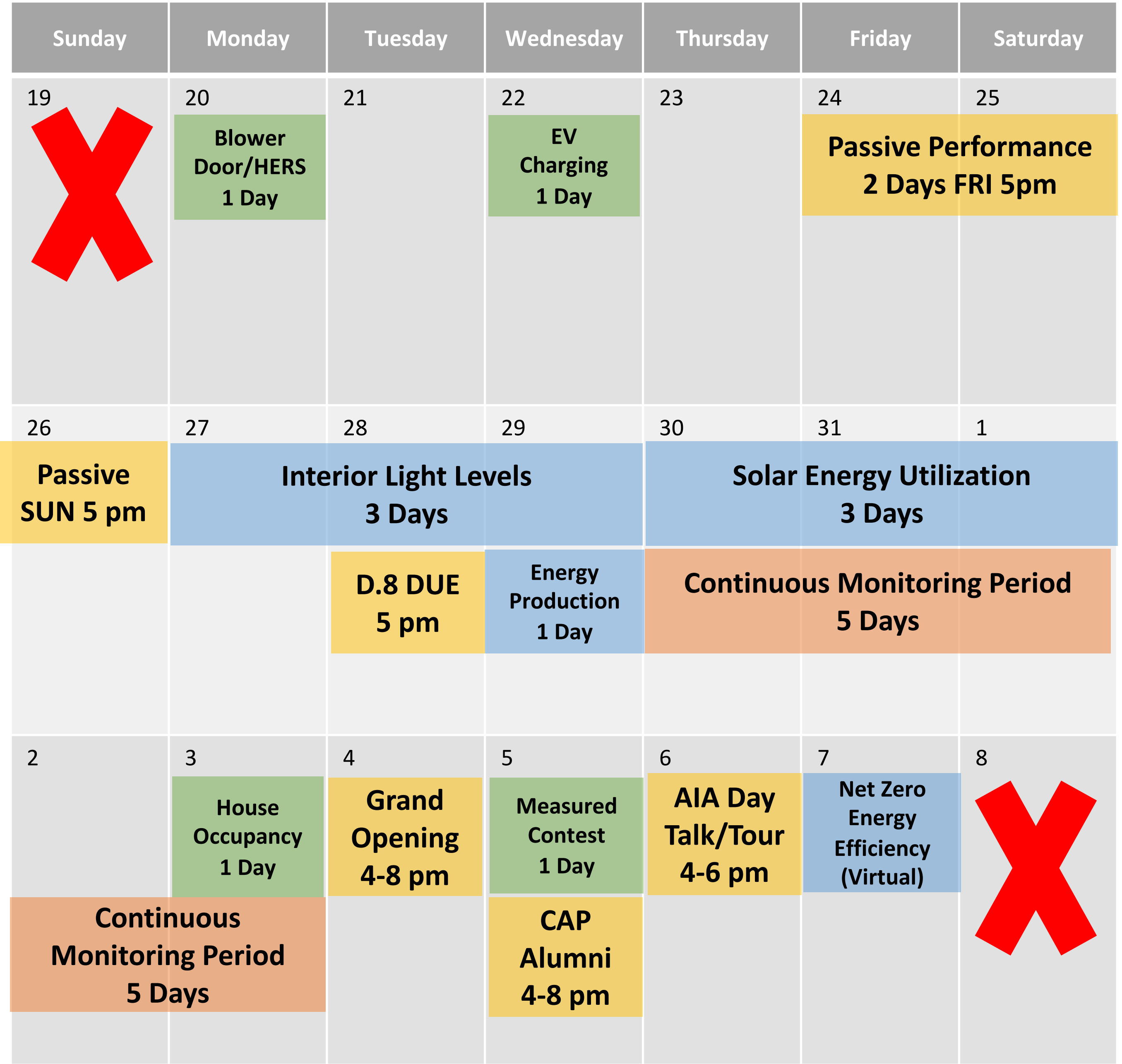
Measured Contest Day 1 Day

Net Zero Energy/Effic Virtual

Passive Performance 2 Days

EV Charging 1 Day

Blower Door/HERS 1 Day

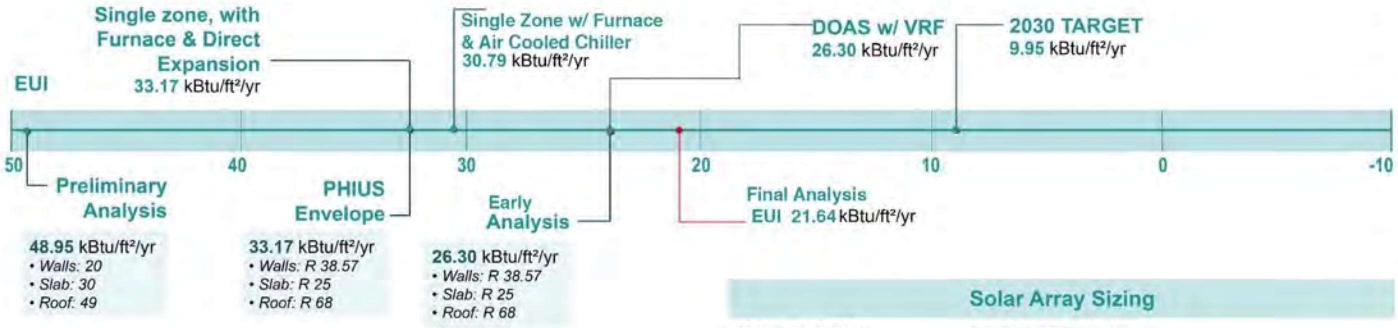


Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
19 ✗	20 Blower Door/HERS 1 Day	21	22 EV Charging 1 Day	23	24 Passive Performance 2 Days FRI 5pm	25
26 Passive SUN 5 pm	27 Interior Light Levels 3 Days	28 D.8 DUE 5 pm	29 Energy Production 1 Day	30 Solar Energy Utilization 3 Days Continuous Monitoring Period 5 Days	31	1
2 Continuous Monitoring Period 5 Days	3 House Occupancy 1 Day	4 Grand Opening 4-8 pm	5 Measured Contest 1 Day CAP Alumni 4-8 pm	6 AIA Day Talk/Tour 4-6 pm	7 Net Zero Energy Efficiency (Virtual)	8 ✗

Phius Prescriptive Path Targets

BUILDING DESIGN ELEMENT	ZERO ENERGY READY HOME TARGET	PHIUS PRESCRIPTIVE TARGET
Roof R-value	2021 IECC Prescriptive U-factor = 0.024 (R-42)	R = 66 effective
Wall R-value	2021 IECC Prescriptive U-factor = 0.045 (R-23)	R = 35 effective
Window U-factor	0.30	0.17
Window SHGC	0.40	0.40
Airtightness	ACH50 = 3.0	0.04 cfm/ft^2 enclosure
Water heater EF	UEF = 2.57	UEF ≥ 3.0
Whole-house mechanical ventilation	2.9 cfm/W; heat exchange not required	1.2 cfm/W; heat exchange required
Lighting efficacy	100% Energy Star varies from 33 to 60 lm/W	≥ 83 lm/W

Performance For Energy



Single zone, with Furnace & Direct Expansion 33.17 kBtu/ft²/yr

Single Zone w/ Furnace & Air Cooled Chiller 30.79 kBtu/ft²/yr

DOAS w/ VRF 26.30 kBtu/ft²/yr

2030 TARGET 9.95 kBtu/ft²/yr

Preliminary Analysis

48.95 kBtu/ft²/yr
- *Walls: 20*
- *Slab: 30*
- *Roof: 49*

PHIUS Envelope

33.17 kBtu/ft²/yr
- *Walls: R 38.57*
- *Slab: R 25*
- *Roof: R 68*

Early Analysis

26.30 kBtu/ft²/yr
- *Walls: R 38.57*
- *Slab: R 25*
- *Roof: R 68*

Final Analysis
EUI 21.64 kBtu/ft²/yr

Solar Array Sizing

West Unit EUI:	21.64 kBTUs/sf/yr
Annual Energy Use:	21.64 EUI x 1,386 SF = 29,993 kBTUs
kBTUs/kWH conversion:	29,993 kBTUs x 0.293 = 8,788 kWh
Oversizing:	8,788 kWh +10% = 9,667 kWh
Via PV Watts Calculator:	An 8.8 kW array of premium modules on 14 deg(3:12) roof produces = 12,181 kWh
Number of PV Panels Needed:	8.8 kW x 1,000w/400w = 22 panels

Net-positive Energy Design

The Alley House is all electric, eliminating dependence on fossil fuels while improving building performance and occupant comfort. Students optimized energy use resulting in an Energy Use Intensity (EUI) of 21.64 kBtu/ft2/yr (calculated with COVE. Tool). Preliminary analysis of EUI was 48.95 kBtu/ft2/yr. Through design development, we effectively reduced EUI value by 55.8%. West Unit is net positive energy using 8.8kWh/yr PV system composed of 22 Panasonic Evervolt 400-watt modules. This array produces 21,181 kWh/yr (calculated with Helioscope), a 38% energy surplus.

- Passive heating concrete thermal mass storage offsets active system
- Passive cooling cross + stack ventilation offsets active system in shoulder season
- Daylighting reduces daytime electric load
- Mitsubishi low ambient, split system heat pump heating/cooling is 1.5 ton
- Heating/cooling uses shortducted, soffit mounted air handlers
- Two zones allow upper + lower floor control of heating/cooling
- AO Smith heat pump water heater provides real-time monitoring and control use
- Condensing dryer extracts ambient heat/discharges dehumidified cooler air
- All appliances are Energy Star rated
- Appliances powered by solar PV + backup battery during weather emergencies

Inputs

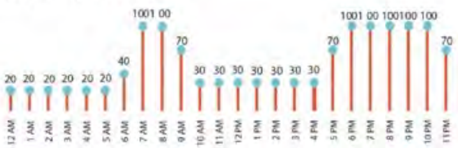
R-Values

Walls: **R 40**
Slab: **R 20**
Floor: **R 92**
Infiltration Rate: **.04 CFM / ft²**

Assumptions

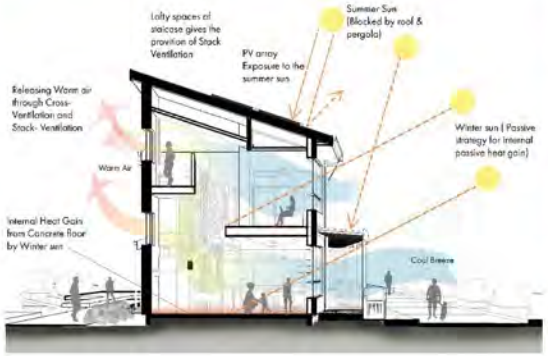
Occupants: **5**
Heating Set Point: **70**
Cooling Set Point: **70**
Lighting: **0.1 W/ ft²**
Appliance Use: **0.25 W / ft²**

Occupancy Schedule



AeroBarrier Application

Passive Systems Diagram



EUI

21.64
kBtu/ft²/yr

Breakdown

- Pumps - **0.7**
- Lighting - **0.81**
- Cooling - **1.31**
- Fans - **1.44**
- Heating - **4.62**
- Equipment - **4.62**
- Hot Water - **8.14**

Solar Edge is inverter/panel optimizer with app. that gives real time solar production

Solar Array Calculations

Energy Need

EUI (21.64) x Total SF (1,386) = 29,993 btus/yr

29,993 btus/yr x Conversion Value (0.293) = **8,788 kWh/yr**

Energy Produced

8.8kW PV system composed of 22 Panasonic Evervolt 400w PV modules = **12,181 kWh/yr** (Estimated using Helioscope software)

12,181 kWh/yr
(Energy Produced)

– 8,788 kWh/yr
(Energy Need)

3,393 kWh/yr
(Energy Surplus)

38%
Energy Surplus

PV Array Specifications

Panasonic EverVolt 410W/400W

Mono-crystalline cells with 21.6 % efficiency

Solar Edge Inverter & Power Optimizers

Maximizes individual production in partially shaded conditions

Measured Contest: Energy Performance

Solar Array Calculations

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EUI (21.64) × Total SF (1,386) = 29,993 btus/yr

29,993 btus/yr x Conversion Value (0.293) = **8,788 kWh/yr**

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8.8kW PV system composed of 22 Panasonic Evervolt 400w PV modules

≈ **12,181 kWh/yr** (Estimated using Helioscope software)

12,181 kWh/yr
(Energy Produced)

– 8,788 kWh/yr
(Energy Need)

3,393 kWh/yr
(Energy Surplus)

38%
Energy Surplus

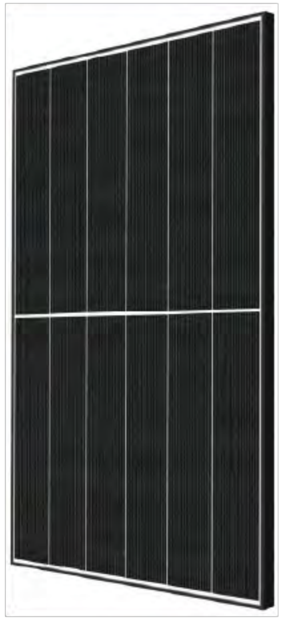
PV Array Specifications

Panasonic EverVolt 410W/400W

Mono-crystalline cells with 21.6 % efficiency

ALLGUARD WARRANTY 25 YEARS

TRIPLE GUARD WARRANTY 25 YEARS
★ PRODUCT
★ PERFORMANCE
★ LABOR

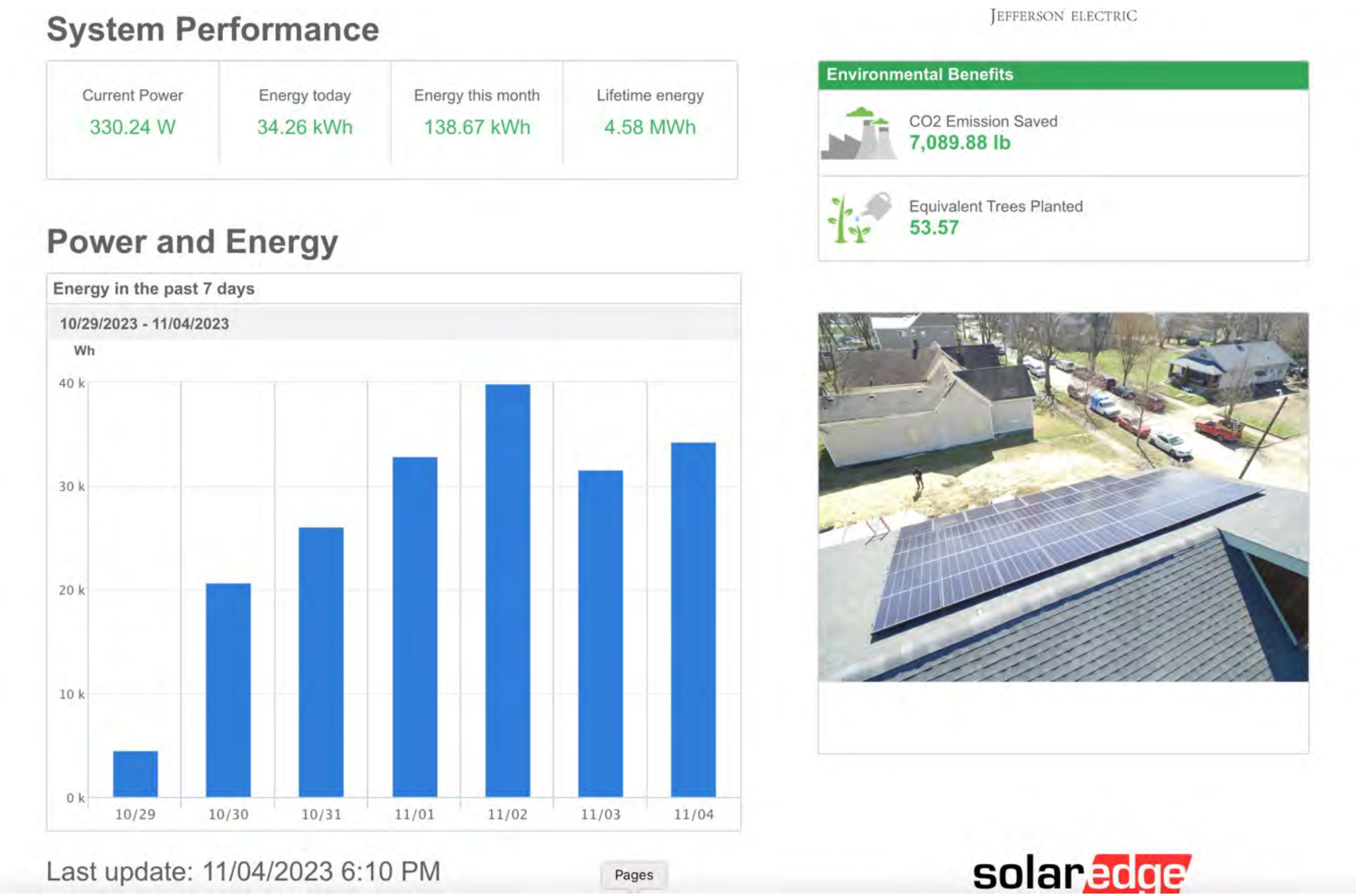


Solar Edge Inverter & Power Optimizers

Maximizes individual production in partially shaded conditions

Measured Contest: Energy Performance

Daylighting limits need for lighting



System Performance

Current Power	Energy today	Energy this month	Lifetime energy
330.24 W	34.26 kWh	138.67 kWh	4.58 MWh

Power and Energy

Energy in the past 7 days

10/29/2023 - 11/04/2023

Last update: 11/04/2023 6:10 PM

JEFFERSON ELECTRIC

Environmental Benefits

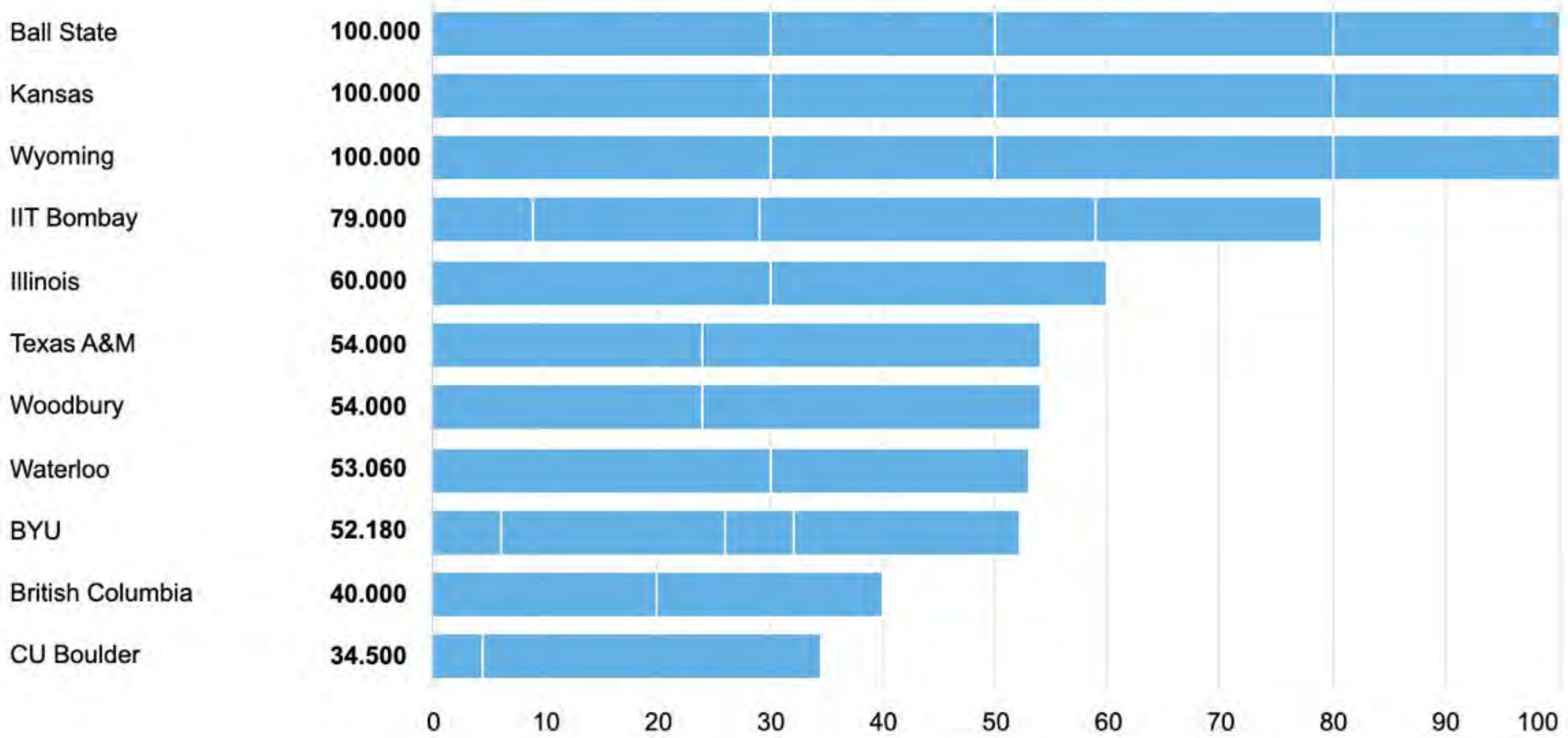
CO2 Emission Saved
7,089.88 lb

Equivalent Trees Planted
53.57

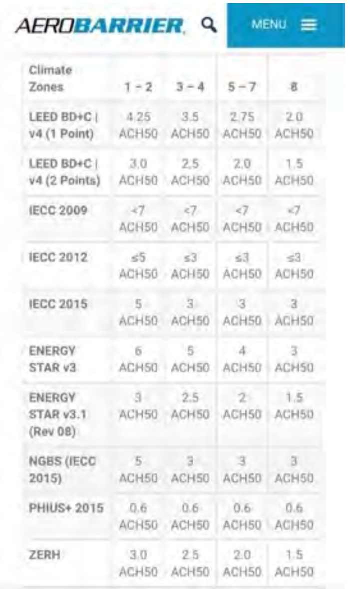
Energy Performance Contest Scores

Energy Performance

This Contest evaluates whole-building energy consumption and how it is offset by renewable energy systems.


Energy Performance Contest Scores

Measured Contest: Integrated Performance



Climate Zones	1 – 2	3 – 4	5 – 7	8
LEED BD+C | v4 (1 Point)	4.25 ACH50	3.5 ACH50	2.75 ACH50	2.0 ACH50
LEED BD+C | v4 (2 Points)	3.0 ACH50	2.5 ACH50	2.0 ACH50	1.5 ACH50
IECC 2009	<7 ACH50	<7 ACH50	<7 ACH50	<7 ACH50
IECC 2012	≤5 ACH50	≤3 ACH50	≤3 ACH50	≤3 ACH50
IECC 2015	5 ACH50	3 ACH50	3 ACH50	3 ACH50
ENERGY STAR v3	6 ACH50	5 ACH50	4 ACH50	3 ACH50
ENERGY STAR v3.1 (Rev 08)	3 ACH50	2.5 ACH50	2 ACH50	1.5 ACH50
NGBS (IECC 2015)	5 ACH50	3 ACH50	3 ACH50	3 ACH50
PHIUS+ 2015	0.6 ACH50	0.6 ACH50	0.6 ACH50	0.6 ACH50
ZERH	3.0 ACH50	2.5 ACH50	2.0 ACH50	1.5 ACH50

Monitored Contest: Integrated Performance

1. Hunter Acumen 42" Ceiling Fan 100 lumens/watt

2. Lithonia Wafer Lights 82.14 Lumens/watt

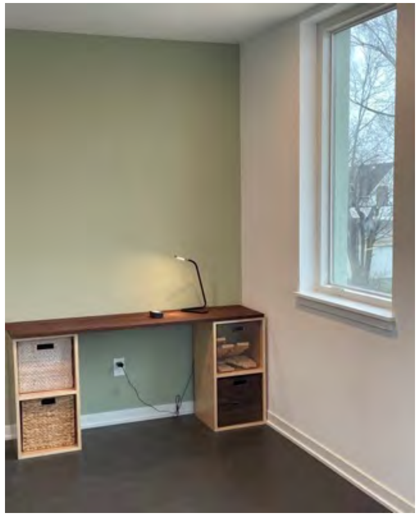
3. Autelo entry light 90 lumens / watt

4. Eglo Sabinar Pendant Light 88.89 Lumens/watt

5. Vallmora Bathroom Light 88.89 Lumens/watt

6. Citalali Aluminum Wall Light at Doors 88.89 Lumens/watt

Light sensors in kitchen & study



COMFORT

LIGHT & WATER

LIGHTING

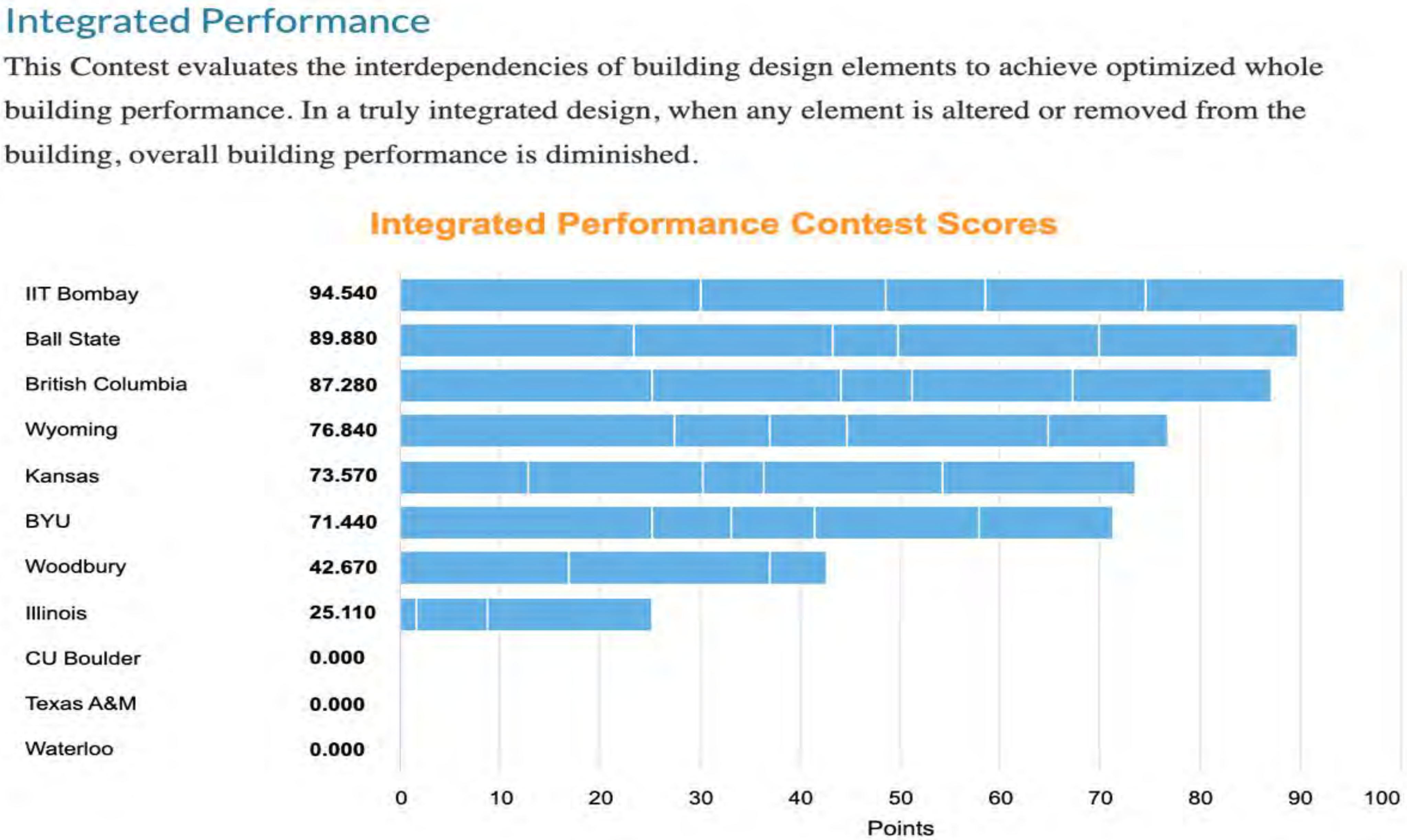
- Turn lights ON at night
- Turn lights OFF during the day
- Windows bring in sunlight during the day
- Light from windows saves energy
- Light from windows saves money
- Light from windows keeps you healthy & helps your body maintain a natural circadian rhythm (day/night cycle)

HOT WATER

- The hot water tank is in the mechanical closet
- Hot water uses A LOT of energy
- Making hot water costs you money
- Do not adjust the temperature on the hot water tank (for safety)
- Push the VACATION button if you will be Away
- TURN OFF the vacation setting when you get back.
- The tank is different than typical ones. It may be louder and it may make the closet cold.
- Tank can be adjusted. Ask Englewood CDC to help

8

Integrated Performance Contest Scores



Integrated Performance

This Contest evaluates the interdependencies of building design elements to achieve optimized whole building performance. In a truly integrated design, when any element is altered or removed from the building, overall building performance is diminished.

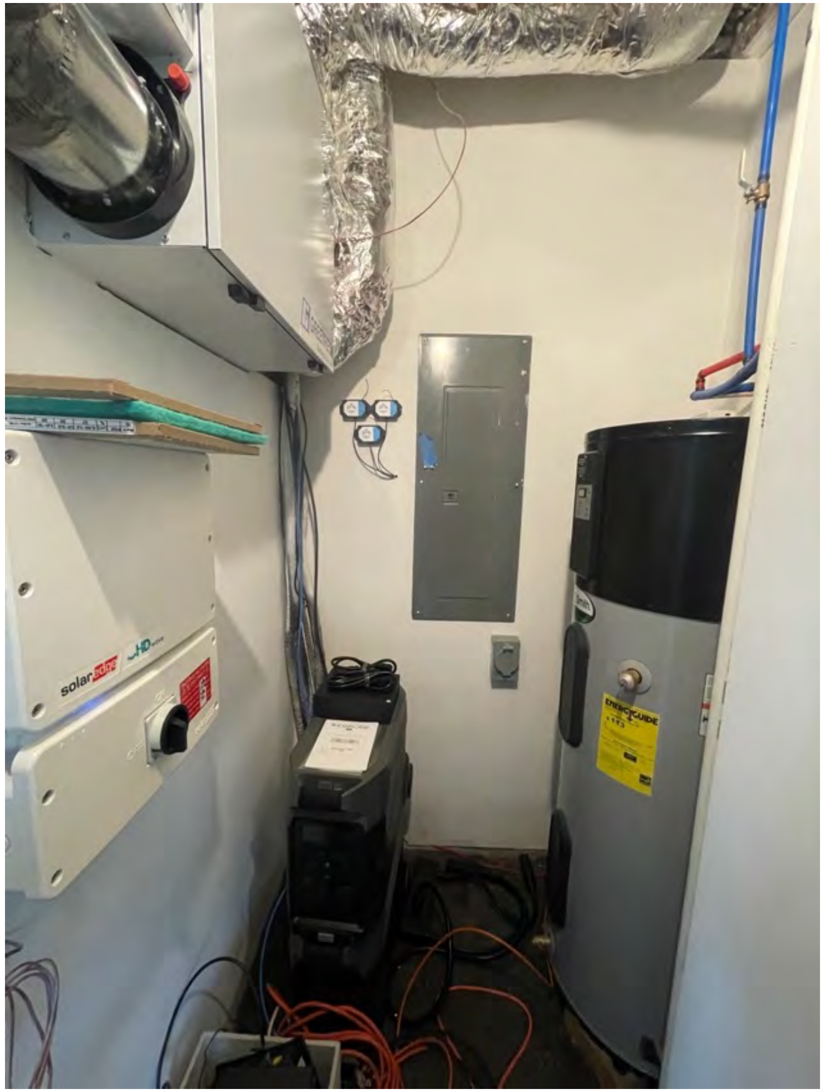
Integrated Performance Contest Scores

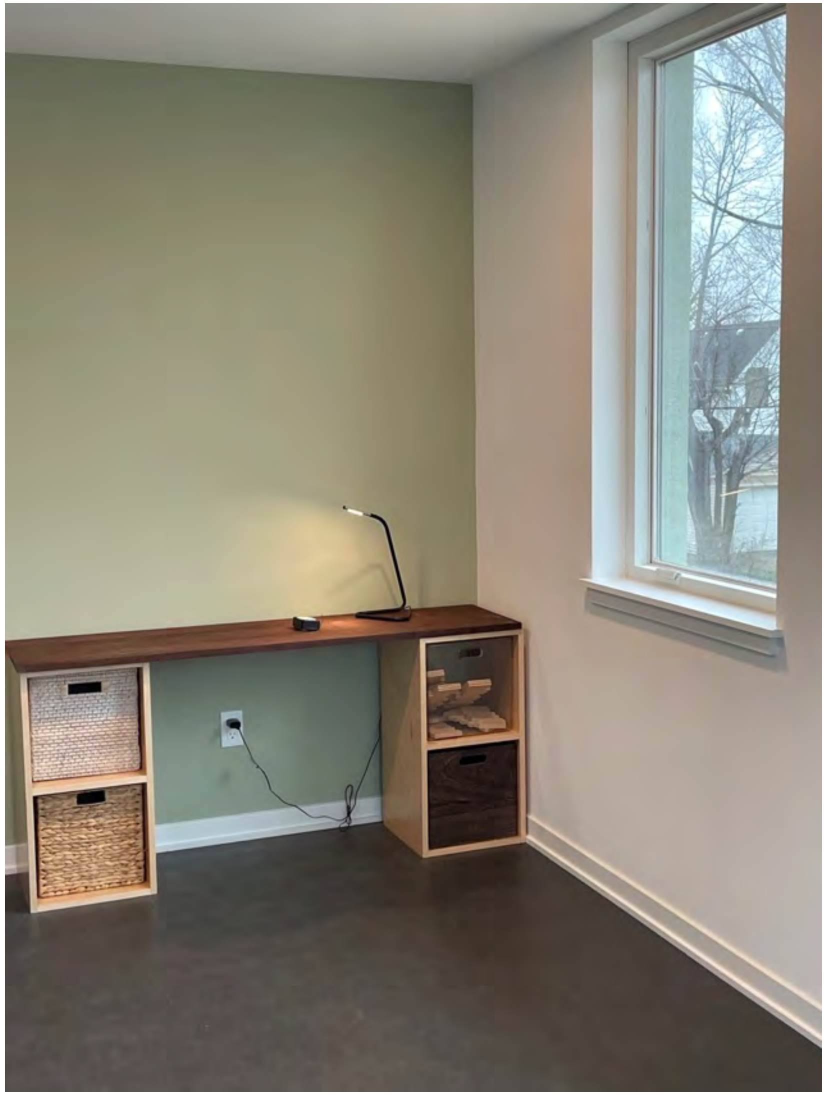
IIT Bombay	94.540
Ball State	89.880
British Columbia	87.280
Wyoming	76.840
Kansas	73.570
BYU	71.440
Woodbury	42.670
Illinois	25.110
CU Boulder	0.000
Texas A&M	0.000
Waterloo	0.000

Integrated Performance Compared

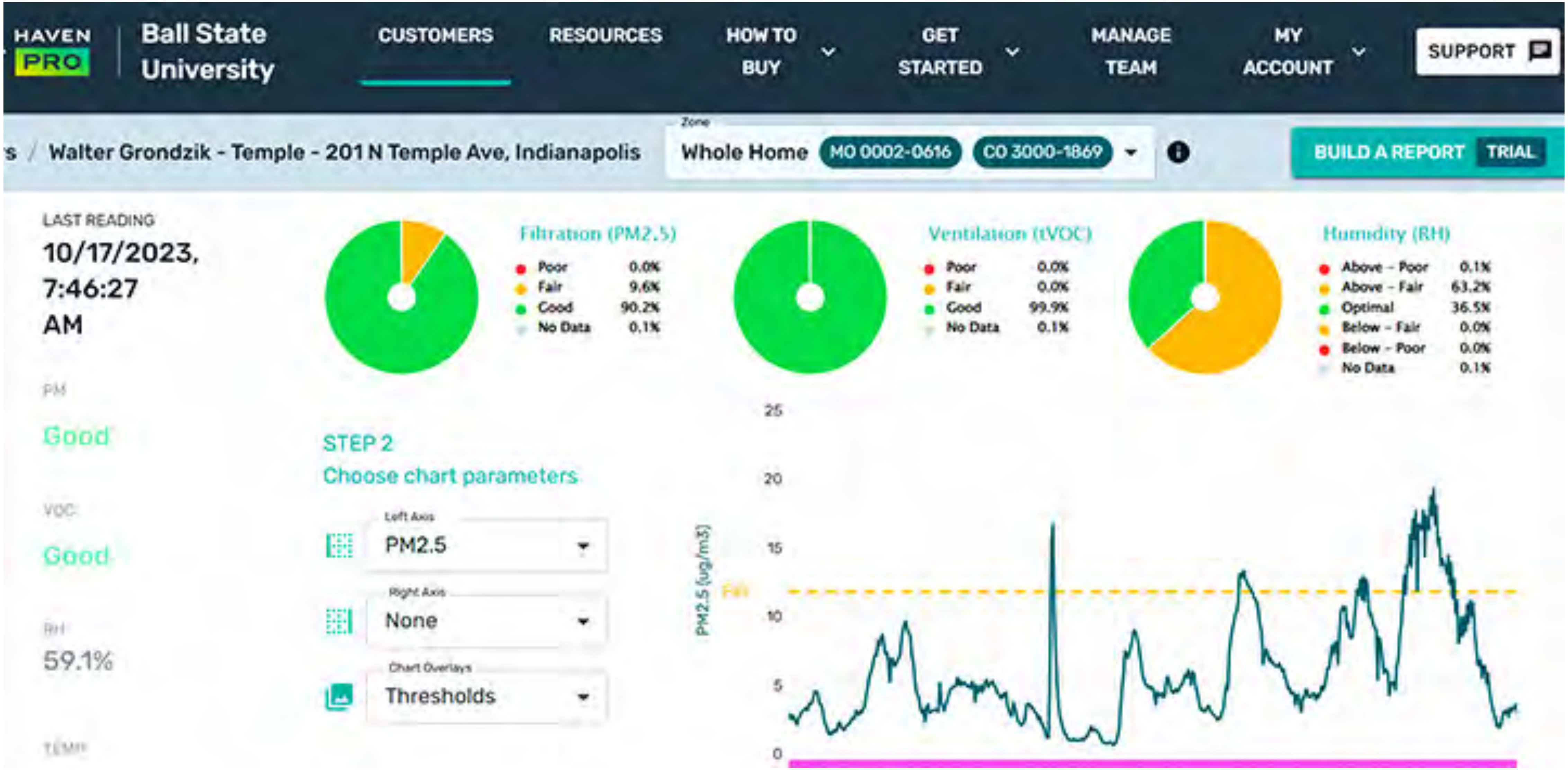
SOLAR DECATHLON CHALLENGE		SUPPORTING PHIUS ELEMENTS
Integrated Performance: ***Airtightness Subcontest—*** All available points are earned for a measured air tightness of less than or equal to 0.05 cfm50/ft^2		Exceptionally low infiltration; quality assurance protocols that involved multiple blower door tests
Integrated Performance: ***Passive Performance Subcontest—*** The home's ability to retain interior thermal comfort over a 48-hour period without the use of active heating or active cooling		Exceptionally low infiltration; triple paned windows; high-R enclosure; verified solar control; reduced interior loads resulting from lighting and appliance efficiency
Integrated Performance: ***Lighting Illuminance Subcontest—*** 300-1,500 lx monitored over 3 days		Excellent daylighting offer little use of electric lighting during daytime; verified lighting efficacy > 83 lm/W in light fixtures

Measured: Comfort & Environmental Quality





Measured: Comfort & Environmental Quality



s / Walter Grondzik - Temple - 201 N Temple Ave, Indianapolis

Zone: Whole Home MO 0002-0616 CO 3000-1869

LAST READING
10/17/2023, 7:46:27 AM

PM
Good

VOC
Good

RH
59.1%

TEMP

Filtration (PM2.5)

Poor	0.0%
Fair	9.6%
Good	90.2%
No Data	0.1%

Ventilation (tVOC)

Poor	0.0%
Fair	0.0%
Good	99.9%
No Data	0.1%

Humidity (RH)

Above - Poor	0.1%
Above - Fair	63.2%
Optimal	36.5%
Below - Fair	0.0%
Below - Poor	0.0%
No Data	0.1%

Left Axis: PM2.5

Right Axis: None

Chart Overlays: Thresholds

Comfort/Environment & Occupant Experience

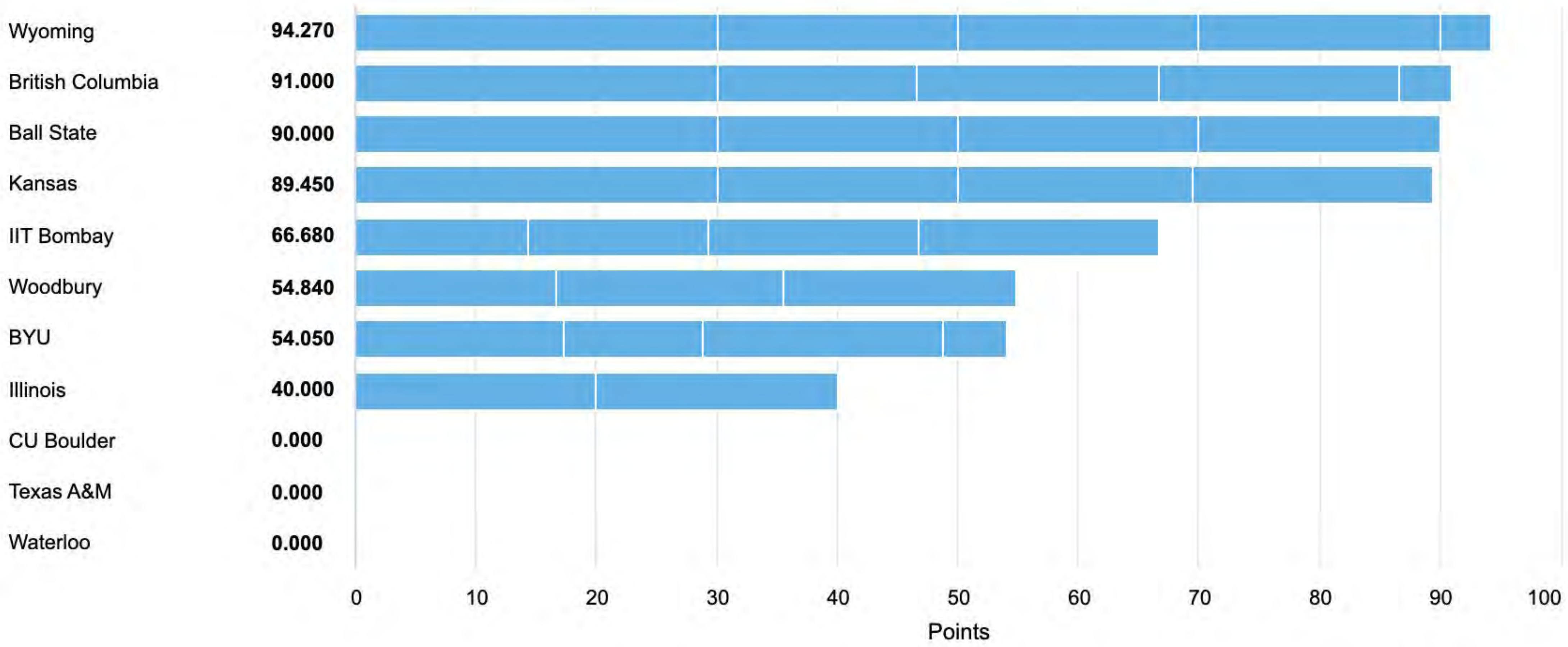
- April 3rd House Occupancy Dinner with 6 guests, 2 from Ball State, 2 from the Community and 2 from the Building Industry with 4 students and faculty.
- April 5th was Alumni Day and One Ball State Day of Giving. 98 past students, now Alumni, came out to see the Alley House.
- April 15th was Ball State Open House Day at the Alley House. Tours and food were enjoyed by 238 attendees, which included the president of Ball State University, the dean of the College of Architecture and Planning, the chair of the architecture department, student and faculty co-leads, and the director of sustainability whom all spoke a few words about the project.

Comfort & Environmental Quality Scores

Comfort & Environmental Quality

This Contest evaluates the building's capability to deliver intended comfort and indoor environmental quality.

Comfort & Environmental Quality Contest Scores



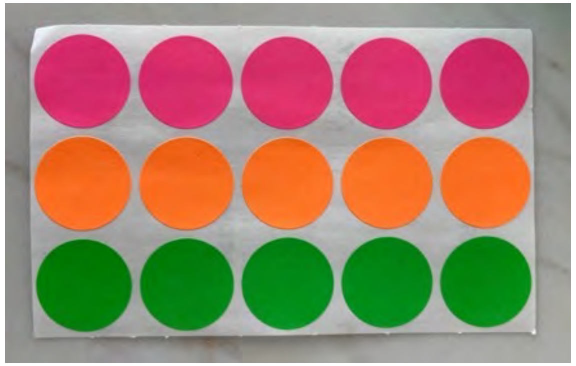
Comfort & Environmental Quality Compared

SOLAR DECATHLON CHALLENGE		SUPPORTING PHIUS ELEMENTS
Comfort and Environmental Quality**:* ***Temperature and Humidity Control Subcontest— All available points are earned for maintaining a time-averaged interior dry-bulb temperature between 68°F and 74°F and a time-averaged relative humidity between 35% and 50%.		Exceptionally low infiltration; triple paned windows; high-R enclosure; verified solar control
Comfort and Environmental Quality**:* ***Indoor Air Quality Subcontest— All available points are earned for a time-averaged interior CO2 level below 1,000 PPM following occupancy of at least 8 individuals for 1 hour.		Balanced ventilation using an ERV; compliance with the EPA's IndoorAir PLUS program

Comfort & Environmental Quality Compared

SOLAR DECATHLON CHALLENGE		SUPPORTING PHIUS ELEMENTS
Comfort and Environmental Quality*: *Comfort Gradient Subcontest— All available points are earned for achieving a maximum delta of time-averaged interior dry-bulb temperatures of 3°F across all measurement locations.		Exceptionally low infiltration; triple paned windows; high-R enclosure; verified solar control; concern for air distribution
Comfort and Environmental Quality*: *Exterior Noise Infiltration Subcontest All available points are earned for a measured sound pressure level from outside noise intrusion less than or equal to 35 dBA based on peak hour sound level equivalents of 90 dBA.		Exceptionally low infiltration; triple paned windows; high-R enclosure *Oddly the Alley House did not do well in this subcontest—despite the above design moves*

Measured Contest: Occupant Experience



Measured Contest: Occupant Experience

RESIDENT GUIDE

COMFORT

FRESH AIR

SYSTEM

- Fresh air keeps you happy & healthy
- The ventilation system runs all the time
- The system brings in fresh air
- The system gets rid of stale air
- You don't need to adjust it at all
- Equipment is in the mechanical room

BOOST

- TIMER SWITCHES behind the stove and in the bathrooms
- USE when there is a lot of steam from cooking
- USE when there is a lot of steam from showers
- It turns the exhaust up for a few minutes

CEILING FANS

- TURN ON Ceiling fans in each room
- Fans will make you feel cooler
- Fans use very little electricity
- Fans make a house feel less stuffy
- Fans let you set thermostats higher to save energy

COMFORT

HEAT & AC

HEAT

- On thermostat, select **Mode** and then **Heat**

Set the thermostats to:

- 68-70 degrees WHEN YOU ARE HOME
- 61 degrees WHEN SLEEPING OR AWAY
- Thermostats can be programmed. Ask Englewood CDC to help

AIR-CONDITIONING (AC)

- On thermostat, select **Mode** and then **Cool**

Set the thermostats to:

- 77-78 degrees WHEN YOU ARE HOME
- 77-78 degrees WHEN SLEEPING
- 84 degrees WHEN AWAY
- 80-82 degrees IF USING CEILING FANS
- Pull blinds in summer to keep sun out
- Thermostats can be programmed. Ask Englewood CDC to help

WASTING ENERGY

- Keeping the heat too high in winter or the AC too low in summer wastes energy.
- Energy is expensive
- Turning thermostats down or up when not home or sleeping **saves you money**

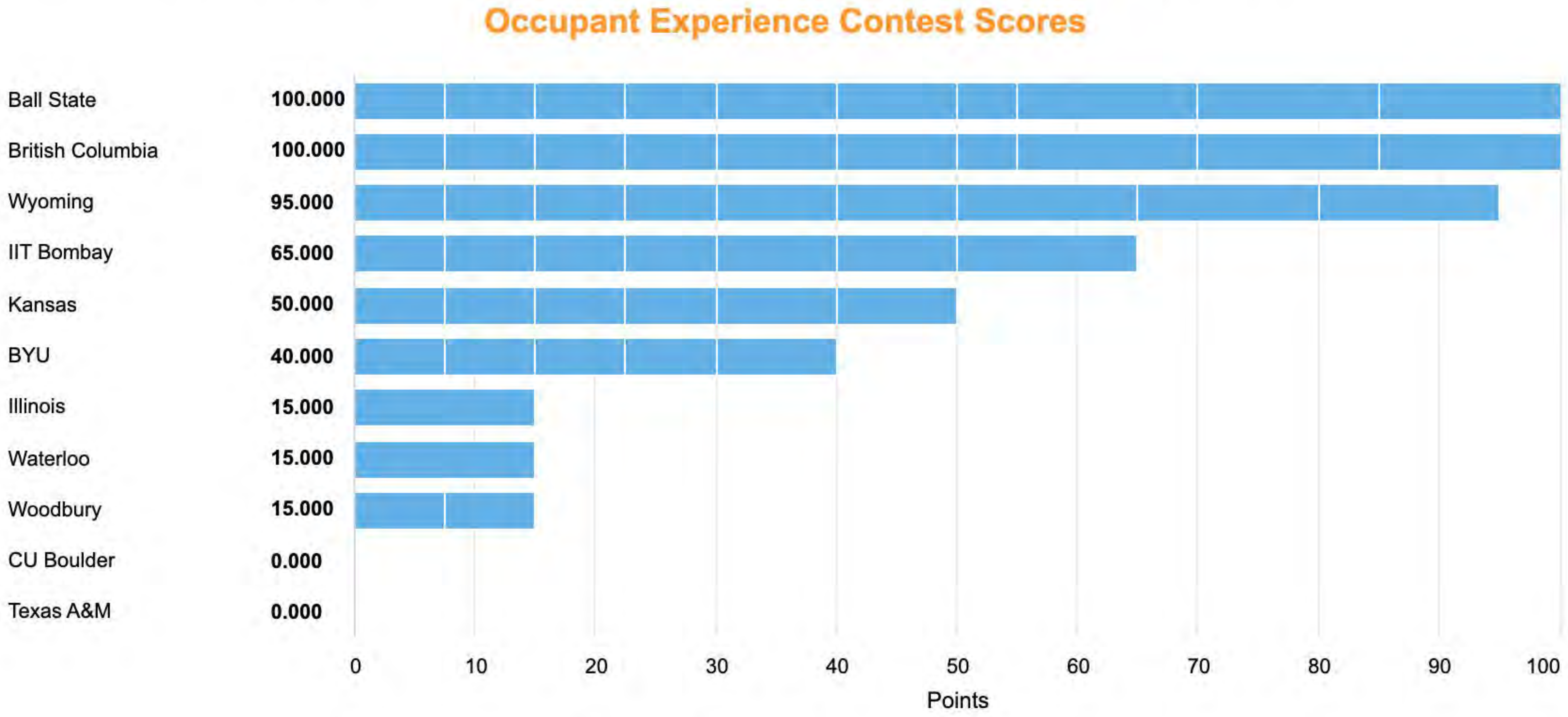
SYSTEM

- Equipment is hidden in the drop down ceilings in the kitchen and upstairs flex space
- Thermostats are near downstairs bathroom & upstairs bedroom doors
- Upstairs has one thermostat
- Downstairs has one thermostat
- Outdoor unit will blow warm air

Occupant Experience Contest Scores

Occupant Experience

This Contest evaluates how the building design prioritizes occupant experience, productivity, and quality of life.



Juried Contest: Durability & Resilience

Locally Sourced Materials

- Thermally modified wood used on exterior and interior details
- Reclaimed limestone slabs for walkway set in gravel
- Reclaimed walnut wood for built-ins
- Cement board siding with rainscreen for moisture control and durability

Design & Construction Detail

- Well-detailed continuous control layers and rain screen

Manufacturers' Warranties

- Reduce maintenance burden for occupants
- Improve building longevity
- Resident Guide for use of the Alley House explaining passive design strategies and active systems

EcoFlow Delta Pro 2

- Portable and expandable backup system
- Outlet to plug into when power outage to utilize battery backup
- Interlock in electrical panel can easily be toggled by the homeowner during power outages
- Two batteries – 7200W, 240V output
- 7.2 kWh capacity total

Weathering an Outage

During an outage, it is estimated that the EcoFlow Delta Pro 2 system can power the following critical functions:

Refrigerator: 4 days

Lighting: 8 days

Air conditioner: 7 hours

Solar Edge Inverter and power optimizer

Interlock device for toggling power source

Battery backup system set up in the mechanical room

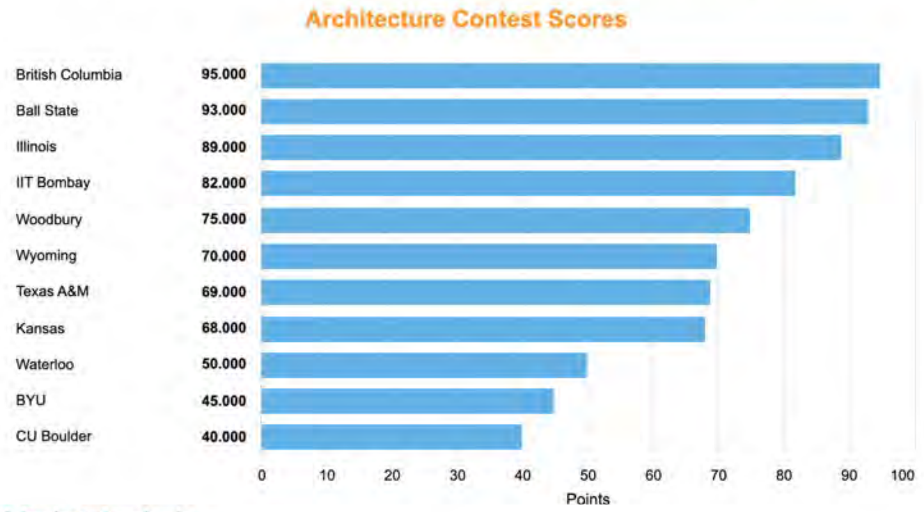
Durability & Resilience Compared

SOLAR DECATHLON CHALLENGE		SUPPORTING PHIUS ELEMENTS
Durability and Resilience*:** ***Durability— The ability of the building envelope to maintain long-term performance despite routine environmental conditions		Continuous control layers that were well-articulated, well-detailed, and site inspected; substantively reduced infiltration
Durability and Resilience*:** ***Resilience— The ability of the building to maintain critical operations during disruptions and quickly restore normal operations.		Battery backup system with substantially reduced heating and cooling loads that extend the life of battery backup during outages

Juried Contest Areas Results

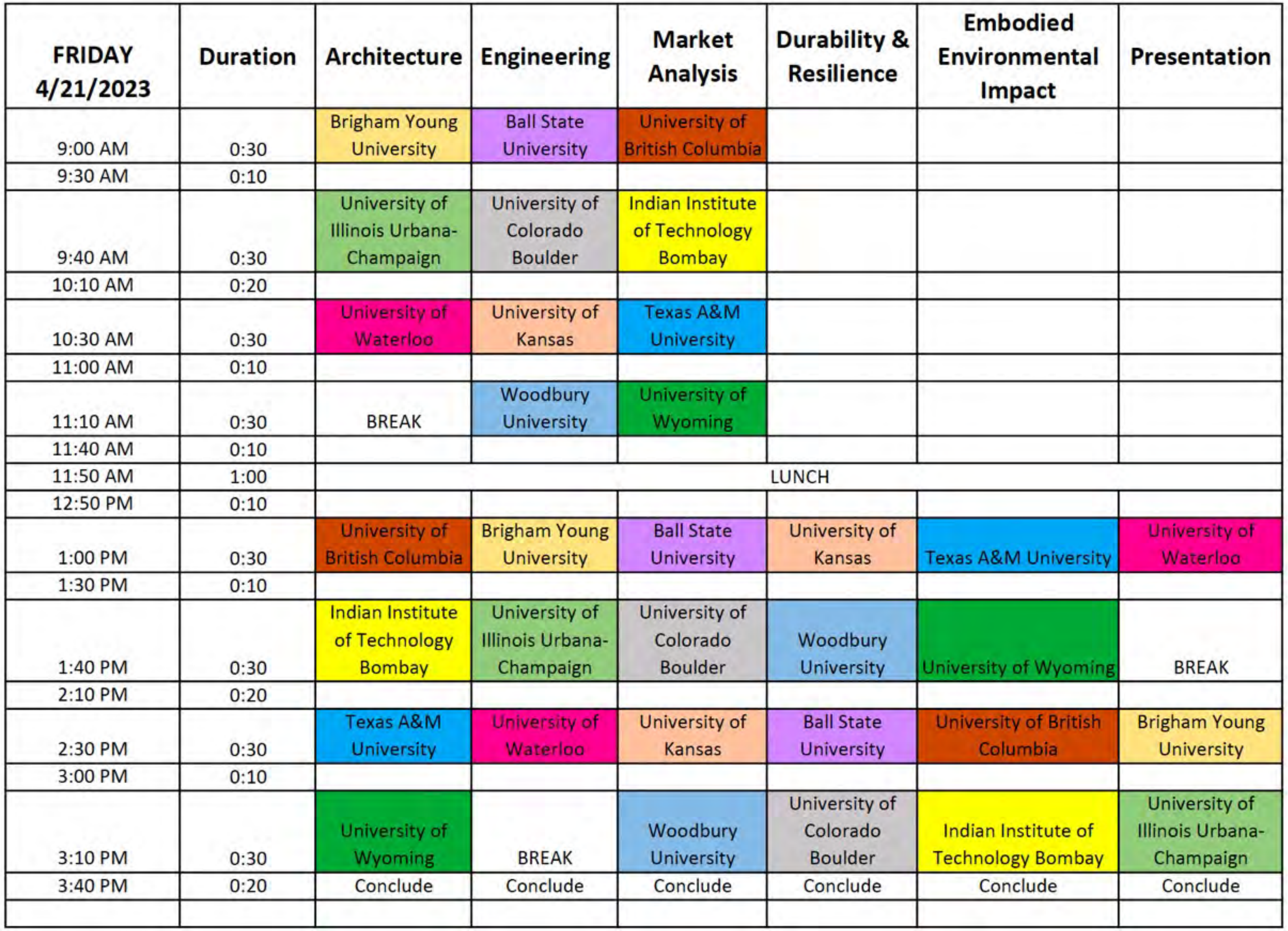
Architecture

This Contest evaluates the building's architecture for creativity in matching form with function, overall integration of systems, and ability to deliver both outstanding aesthetics and functionality.



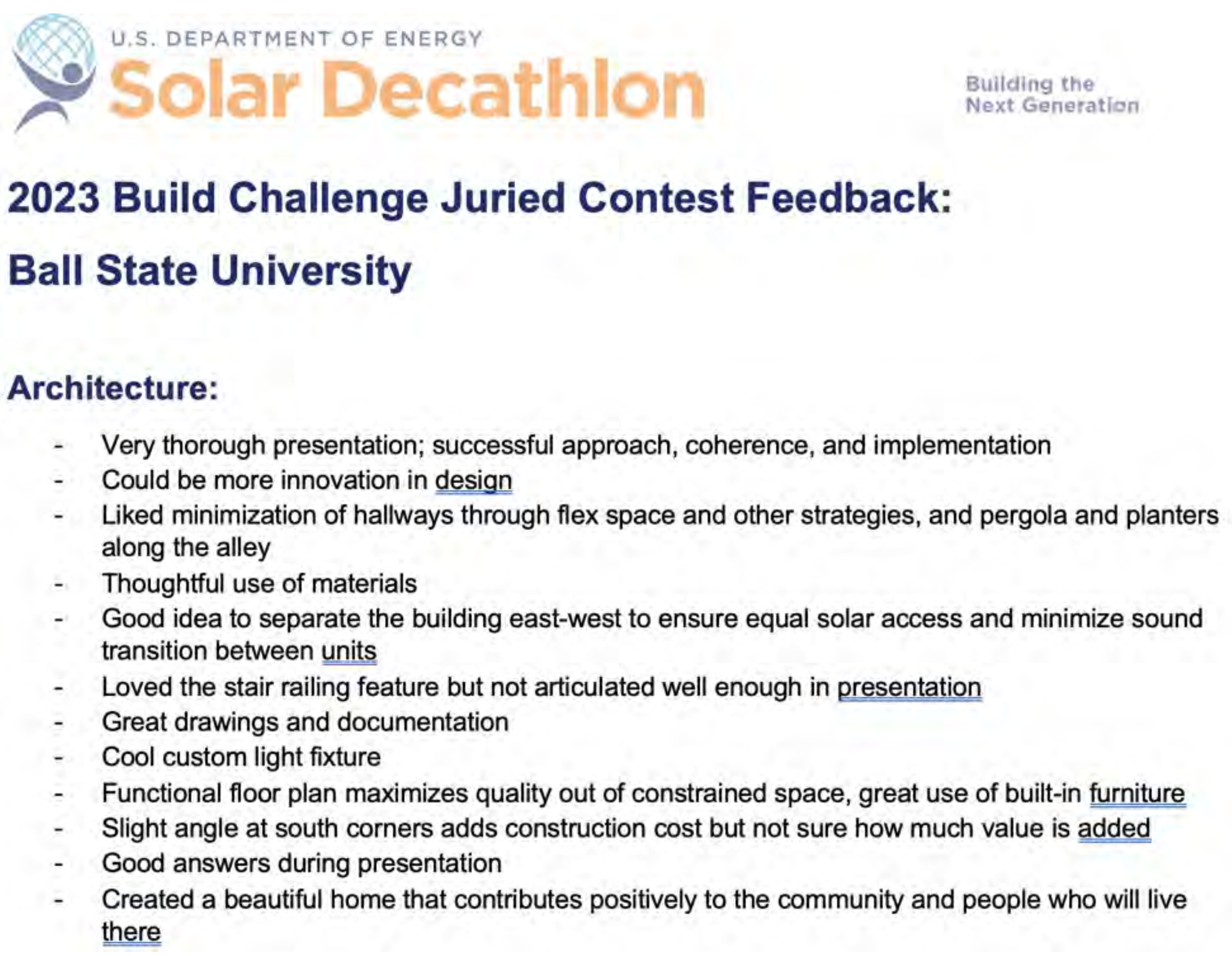
Market Analysis

This Contest evaluates the building's appeal, affordability, and attainability to the stated target market. This includes addressing specific market needs, such as affordability and financial feasibility, and socioeconomic barriers to increase likelihood of adoption by intended occupants and the construction industry for impactful, cost-effective design.



FRIDAY 4/21/2023	Duration	Architecture	Engineering	Market Analysis	Durability & Resilience	Embodied Environmental Impact	Presentation
9:00 AM	0:30	Brigham Young University	Ball State University	University of British Columbia			
9:30 AM	0:10						
9:40 AM	0:30	University of Illinois Urbana-Champaign	University of Colorado Boulder	Indian Institute of Technology Bombay			
10:10 AM	0:20						
10:30 AM	0:30	University of Waterloo	University of Kansas	Texas A&M University			
11:00 AM	0:10						
11:10 AM	0:30	BREAK	Woodbury University	University of Wyoming			
11:40 AM	0:10						
11:50 AM	1:00	LUNCH					
12:50 PM	0:10						
1:00 PM	0:30	University of British Columbia	Brigham Young University	Ball State University	University of Kansas	Texas A&M University	University of Waterloo
1:30 PM	0:10						
1:40 PM	0:30	Indian Institute of Technology Bombay	University of Illinois Urbana-Champaign	University of Colorado Boulder	Woodbury University	University of Wyoming	BREAK
2:10 PM	0:20						
2:30 PM	0:30	Texas A&M University	University of Waterloo	University of Kansas	Ball State University	University of British Columbia	Brigham Young University
3:00 PM	0:10						
3:10 PM	0:30	University of Wyoming	BREAK	Woodbury University	University of Colorado Boulder	Indian Institute of Technology Bombay	University of Illinois Urbana-Champaign
3:40 PM	0:20	Conclude	Conclude	Conclude	Conclude	Conclude	Conclude

Juried Contest Areas Comments



U.S. DEPARTMENT OF ENERGY

Solar Decathlon

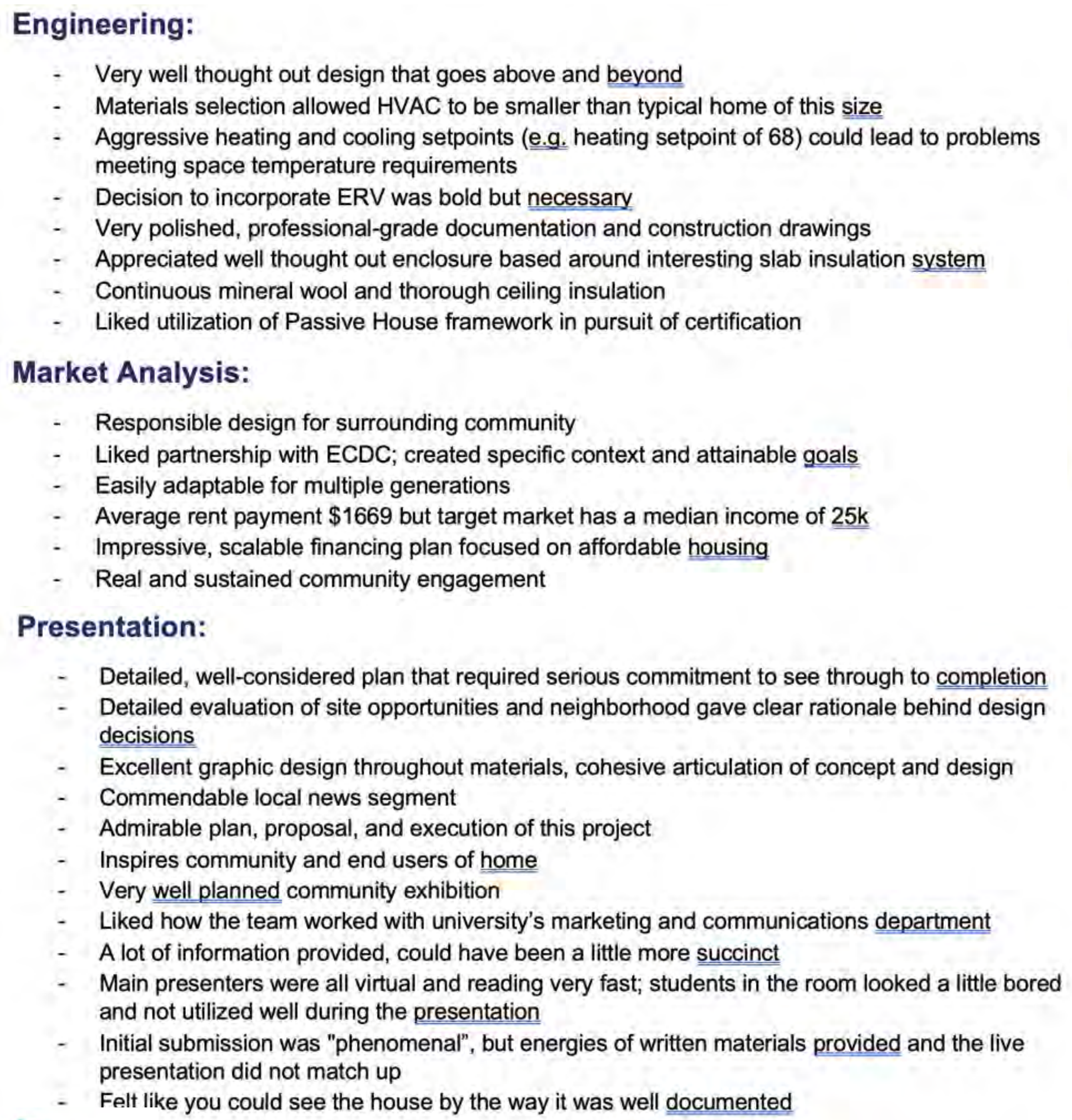
Building the Next Generation

2023 Build Challenge Juried Contest Feedback:

Ball State University

Architecture:

- Very thorough presentation; successful approach, coherence, and implementation
- Could be more innovation in design
- Liked minimization of hallways through flex space and other strategies, and pergola and planters along the alley
- Thoughtful use of materials
- Good idea to separate the building east-west to ensure equal solar access and minimize sound transition between units
- Loved the stair railing feature but not articulated well enough in presentation
- Great drawings and documentation
- Cool custom light fixture
- Functional floor plan maximizes quality out of constrained space, great use of built-in furniture
- Slight angle at south corners adds construction cost but not sure how much value is added
- Good answers during presentation
- Created a beautiful home that contributes positively to the community and people who will live there



Engineering:

- Very well thought out design that goes above and beyond
- Materials selection allowed HVAC to be smaller than typical home of this size
- Aggressive heating and cooling setpoints (e.g. heating setpoint of 68) could lead to problems meeting space temperature requirements
- Decision to incorporate ERV was bold but necessary
- Very polished, professional-grade documentation and construction drawings
- Appreciated well thought out enclosure based around interesting slab insulation system
- Continuous mineral wool and thorough ceiling insulation
- Liked utilization of Passive House framework in pursuit of certification

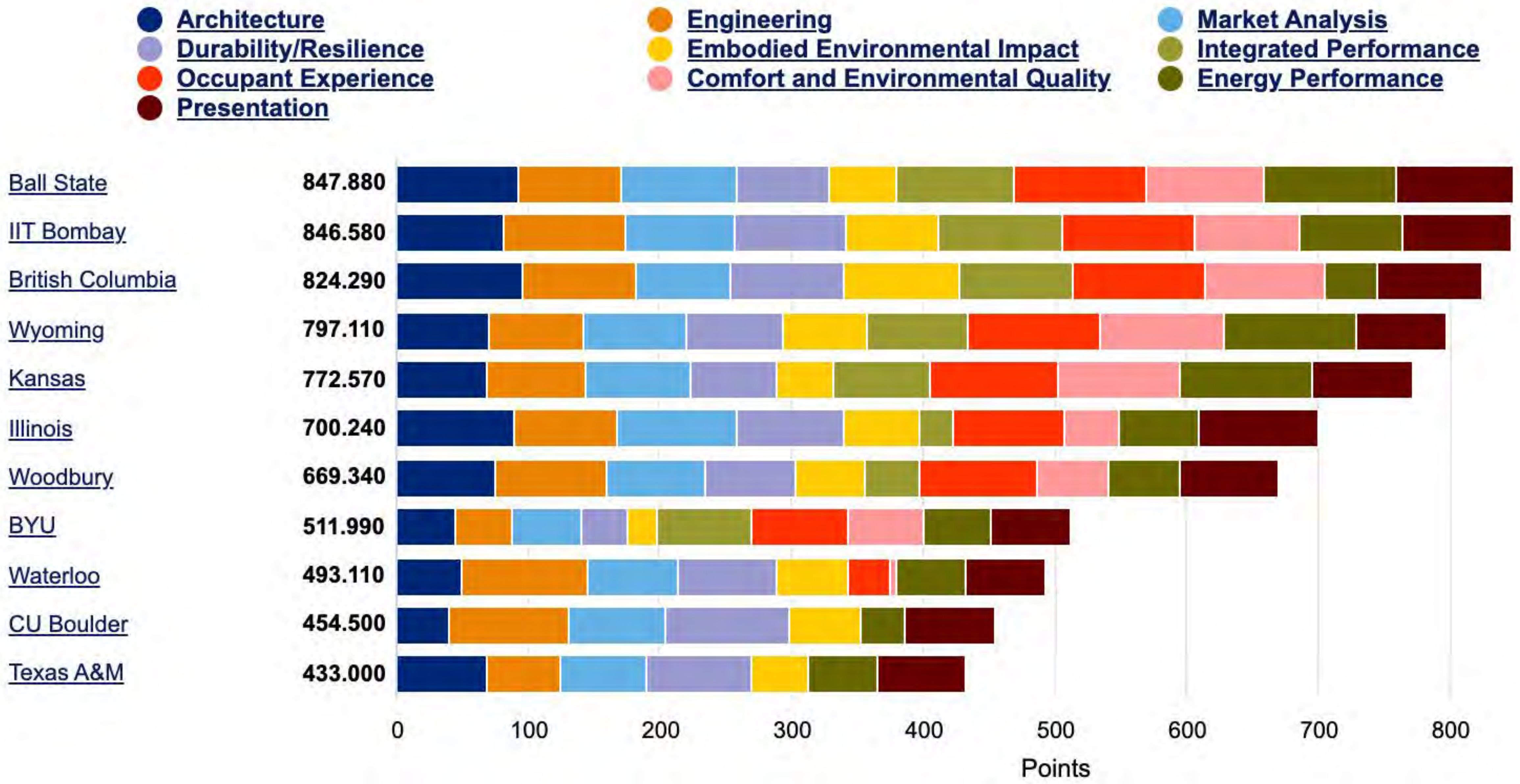
Market Analysis:

- Responsible design for surrounding community
- Liked partnership with ECDC; created specific context and attainable goals
- Easily adaptable for multiple generations
- Average rent payment $1669 but target market has a median income of 25k
- Impressive, scalable financing plan focused on affordable housing
- Real and sustained community engagement

Presentation:

- Detailed, well-considered plan that required serious commitment to see through to completion
- Detailed evaluation of site opportunities and neighborhood gave clear rationale behind design decisions
- Excellent graphic design throughout materials, cohesive articulation of concept and design
- Commendable local news segment
- Admirable plan, proposal, and execution of this project
- Inspires community and end users of home
- Very well planned community exhibition
- Liked how the team worked with university's marketing and communications department
- A lot of information provided, could have been a little more succinct
- Main presenters were all virtual and reading very fast; students in the room looked a little bored and not utilized well during the presentation
- Initial submission was "phenomenal", but energies of written materials provided and the live presentation did not match up
- Felt like you could see the house by the way it was well documented

Measured & Juried Contest Areas Results



ALLEY HOUSE CONCLUSION

Equity – Economy - Environment

Community Engagement & Public Exhibit

Student-Directed Design and Led Tours

Student Hand-Crafted Details in Fabrication

Student Faculty Collaboration

Clear Building Performance Metrics

Thank you

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Dan Porzel, CPHB, Leed AP
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