PROJECT INDY: INFILL REIMAGINED

US DOE Solar Decathlon Design Challenge
Ball State University | College of Architecture & Planning
NEST - Near East Side Team
USF - Urban Single Family
Jury Presentation
EXISTING SITE & CONTEXT

SITE DATA

- 225 N. Oxford St. Indianapolis, IN
- 40' x 165' Parcel / 6,400 Square Feet
- Maximum Elevation: 768
- Minimum Elevation: 765

DESIGN CONSTRAINTS

- 40 ft. wide parcel
- No driveway access from Oxford St.
- 5 ft. setbacks from lot line
- SDDC lot maximum: 5,000 sq. ft.
DESIGN CONSTRAINTS & GOALS

PROJECT GOALS

• An adaptable home to “age in place”
• Manage site water
• Provide passive solutions
• Model the use of CLT for affordable housing

SITE DESIGN

• Permeable concrete pavers, no steps on site
• Pergola for shading and privacy from adjacent neighbors
• Wood shading walls on front porch and back patio
• Concrete paving from home to the ADU
• Roof overhang on front porch for shading
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FLOOR PLANS

First Floor
- Living Room
- Kitchen
- Utility Room
- Master Bedroom
- Full Bath

Second Floor
- Multi-Use Space
- Bedroom
- Full Bath

Spacious & Compact
- Double Height Living Space
- Limiting enclosed rooms
- Circulation open to living spaces
AGING IN PLACE

• Architectural aspects to improve quality of life for seniors
  • Hallway width
  • Bedroom on first floor
  • 36” wide doorways
  • Light switch installation
  • Low maintenance materials

• All doors on first floor are 36” wide

• Hallway is 36” wide to allow easy travel

• Master bedroom located on first floor
INTEGRATED SPACE
- One-Story South Hallway
  - Necessary for circulation
  - Tighten and release
  - Provides light and ventilation
- Tall Ceilings
  - Open room to more light
  - Makes space feel larger
- Saw-Toothed Roof
  - Architectural feature
  - Light/ Ventilation Access

FLOORPLAN
- Mechanical
  - Placed in core of house
  - Outside Access
- Living
  - Front (public space)
  - Back (private space)
- Storage
  - Along Northern wall

INTEGRATED PERFORMANCE
- Limited glazing on north wall, which is used for storage
- Kitchen positioned on the service core wall for access to plumbing, power, and ductwork
- Mechanical room in service core & on exterior wall. Exterior door provides easy access for maintenance
- Double height living space for daylight, views, & stack ventilation
- Stacked Bathrooms With shared plumbing wall
- Reduction of circulation space on 2nd floor reduces the overall SF
- Loft space extends double height space, provides greater access to clerestory, & provides extra living space with views
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INTERIORS

- **Cork Flooring**
  - Warm, soft underfoot
  - Lower embodied impact than alternatives
  - Durable and water resistant with chosen finish

- **Butcherblock counters and shelves**
  - Compliments other wood textures throughout the home
  - Just as durable as alternatives with chosen finish
  - Low cost

- **Neutral colors**
  - The materials chosen should complement any furniture the occupants want in the home

- **Exposed CLT structure**
  - Shows how the home is put together and shows off the wood texture
ENVELOPE

- Exceeds PHIUS 2021 Prescriptive Path requirements
- R-39.6 Wall, R73.7 Roof
- Cross-laminated timber (CLT) construction
- Continuous Smart vapor retarder & air barrier
- Continuous wood fiber insulation with integrated WRB
- Drainage plane/air gap
- Low maintenance steel siding & standing seam roof
- Triple-pane windows (U-0.15)
- Insulated slab on grade (R-20)
EMBODIED ENVIRONMENTAL IMPACT

ENVIRONMENTAL IMPACT ANALYSIS

- PHIUS+ Prescriptive pathway increased the use of insulation in the house
- Wood fiberboard insulation vs. foam insulation
- Increased the use of wood

TRADE-OFFS

- The use of the CLT and a dense amount of insulation has made it a very high-performance building envelope
- Lowered the energy usage of the house
- Allowed for all on-site energy production

Figure: Tally analysis

Legend

Divisions
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal & Moisture Protection
- 08 - Openings & Glazing
- 09 - Finishes
HEATING AND COOLING SYSTEM

- Variable Refrigerant Flow (VRF)
  - Non-ducted system
  - Uses small refrigerant pipes
  - Services multiple zones

- Why this type of system was chosen
  - Each zone can be individually controlled to provide more thermal comfort to occupants
  - One system can provide both heating and cooling simultaneously
  - Efficient operation

VENTILATION SYSTEM

- Energy Recovery Ventilator (ERV)
  - Removes stale air and replaces it with fresh air

- Why this type of system was chosen
  - Efficient operation
  - Good moisture control
  - Quiet operation
  - Easy and quick installation and maintenance
  - Ease of use for occupants
ENERGY USE INTENSITY (EUI)-kBtu/sf/yr
- Average single-family home has an EUI of 50
- Compliance with the DOE Zero Energy Ready Home (ZERH) Standard reduced the EUI to 40
- Compliance with the PHIUS 2021+ Prescriptive Path Standard reduced the EUI to 26.
- With a 9.62 kW solar array, the design has an EUI of -2 and is slightly net-positive
- Calculations done with BEopt

ENERGY RATING INDEX (ERI)
- ERI Used in lieu of a HERS rating
- Average new house in US has an ERI of 100
- Compliance with the PHIUS 2021+ Prescriptive Path Standard reduced the ERI to 40
- With a 9.62 kW solar array, the design has an ERI of -1 and is slightly net-positive
- Calculations done with BEopt
ENERGY PERFORMANCE

PHOTOVOLTAIC SYSTEM
- Panasonic EverVolt 370W
- 9.62 kW system (26 PV modules @ 370 Watts)
- 30-degree mounted flush with south facing roof
- 99% weighted efficiency

CALCULATIONS
- Est. 13,300 kWh/year or 45.38 MMBtu/year
- Extra space for additional future PV expansion
- Potential for 8 additional modules
- + SolarEdge HD Wave inverter and power optimizer

Panasonic EverVolt 370W panel

Rooftop layout of the PV array
CONCLUSION

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- Aging in place
- Durability and resilience
- Infill housing
- Replicability