

DURABILITY & RESILIENCE

DESIGN APPROACH

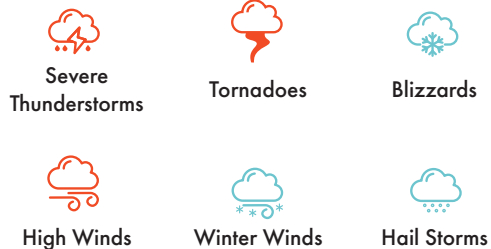
Investing in housing is one of the most important financial decisions a person will make in their lifetime. It often is the most expensive purchase they ever make, and in order to protect that investment, their home should be designed with a goal to be durable and resilient. In alignment with this goal, Cardinal Studio set out to design and build the envelope of the Alley House to withstand the local climate for many years. Without this long-term resilience, the cost of home ownership and maintenance could become a major burden for lower-income households, eventually forcing out families, ending their dreams of home ownership, and returning them to the rental market.

CONTEST OVERVIEW

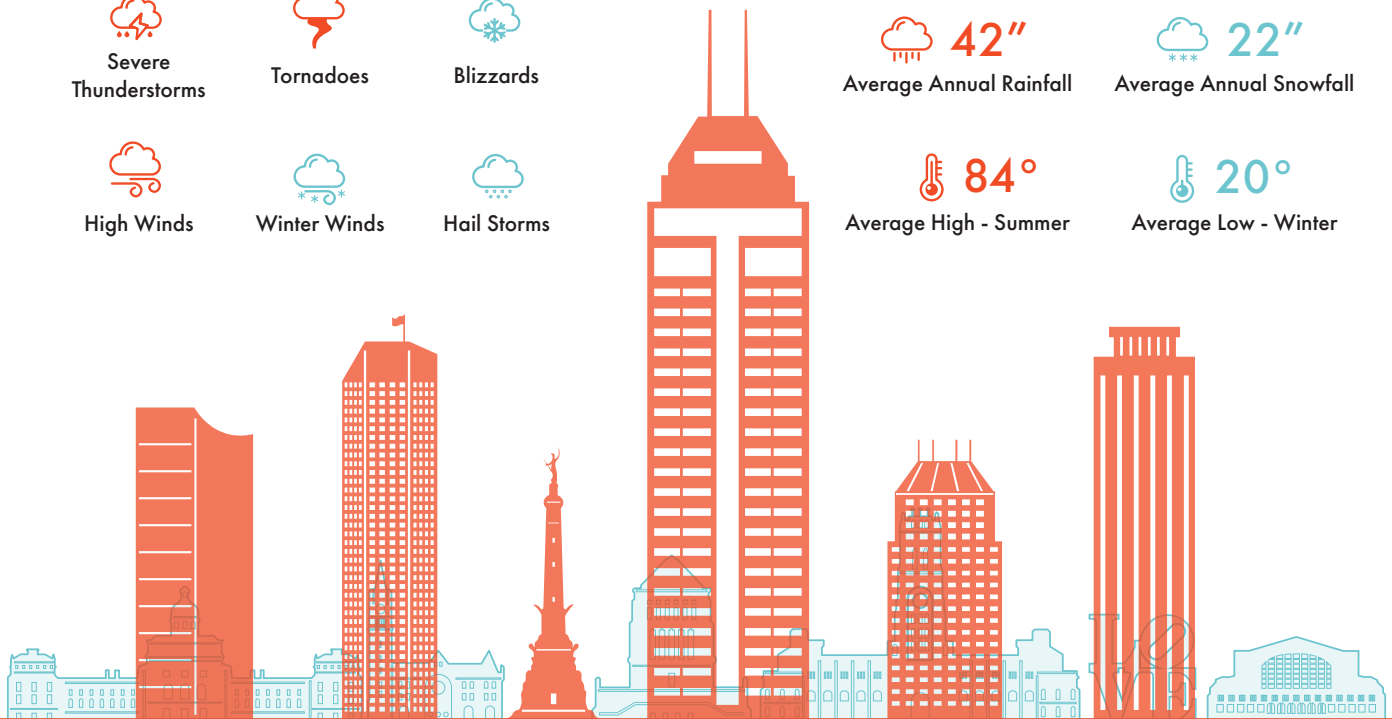
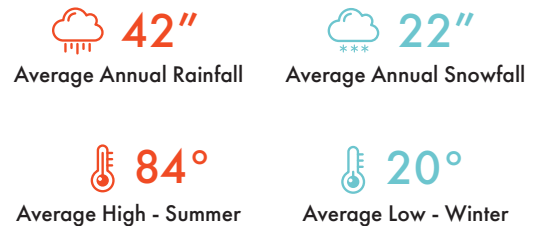


The Midwest has a well-deserved reputation for the wide range of weather it experiences throughout the year. Without large bodies of water that would reduce temperature fluctuations, designers in the Midwest must design for hot, humid summers and bitterly cold, dry winters. Indianapolis experiences all the weather extremes, as well as numerous severe weather events each year. In order to provide a truly durable home, Cardinal Studio designed for three main types of severe weather patterns: extreme thunderstorms that are capable of producing heavy rainfall, lightning, large hail, strong winds, and sometimes tornadoes; long periods of very humid heat without any precipitation; and dry winters that regularly drop below freezing, including winter storms that produce heavy snowfalls and accumulations of ice. All of these weather events have the potential to disrupt the power grid, causing occupant discomfort and loss of utility services. Cardinal Studio felt that it was important to implement a strategy to bridge gaps between power loss and full restoration of the grid. This contingency strategy ensures occupants' safety, minimizes discomfort, and prevents disruptions to the homeowners' daily lives.

Typical Central Indiana Severe Weather



Alley House Design Criteria



INDIANAPOLIS | INDIANA

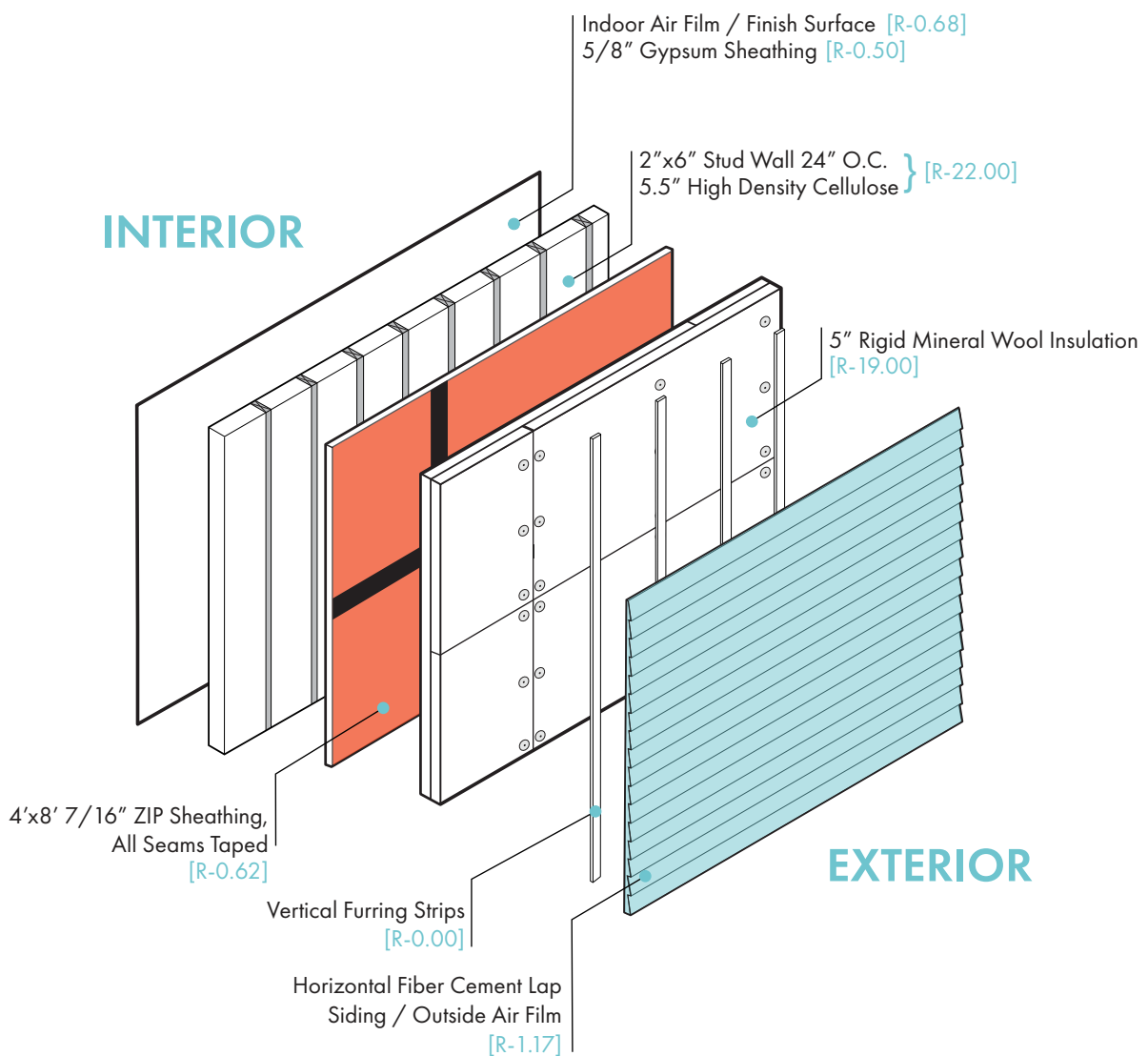
39.7684°N, 86.1581°W

CLIMATE ZONE | 5A

RAIN SCREEN FAÇADE SYSTEM

The most important environmental factor Cardinal Studio considered when designing the exterior envelope was the mitigation of bulk water. Protecting the Alley House from water intrusion is arguably more important than the thermal performance of its walls. Water intrusion can cause catastrophic failures leading to failure of the entire wall or indoor environmental health problems resulting from mold and mildew. The design of the Alley House incorporates a rain screen façade system to allow the layers of the façade to dry to the exterior. This feature allows all of the exterior building components on top

of the bulk water retention layer to dry off completely and prevent formation of rot or mold. The exterior cladding of the home is James Hardie fiber cement lap siding paired with a thermally modified exterior wood cladding product. In conjunction with the furring strips, this cladding design provides the exterior envelope with the ventilation needed to allow warm air to enter from below and exit from the top of the enclosure. The separation also allows any bulk water to drain to the bottom and away from the house through the flashing provided by the fiber cement product.



Wall System Diagram

RIGID INSULATION AND WRB

Cardinal Studio was careful to consider the location of the dew point in relation to where it lays within the wall. It was necessary to keep condensation on the cold side of the sheathing, where a rain screen system was implemented to shed water away from critical building components. This was accomplished by installing a layer of rigid insulation on top of the sheathing. The Alley House is designed with two layers of 2 ½" Rockwool rigid cellulose insulation for a total of 5" of continuous insulation on the exterior of the home. The design specified staggering the 2 ½" layers of rigid insulation joints so that seams do not line up on top of each other, eliminating the possibility of any water and vapor from pushing through the seams and penetrating the sheathing. However, if water is able to find a way through the thermal insulation layer, the Huberwood Zip Sheathing system includes an impregnated weather-resistive barrier (WRB). This WRB is applied to the sheathing product in a controlled factory setting, ensuring that the application is complete and consistent. This system will keep all bulk water out of the wall system of the Alley House and ensure that its exterior envelope will withstand the climate in Indianapolis.



Rockwool Installation

INSULATED DUCT WORK

The design of Alley House utilizes an independently dedicated, ducted energy recovery ventilator (ERV) system to provide continuous fresh air in all rooms to improve indoor air quality. In an ERV system, incoming fresh air is unconditioned at first. In winter, outdoor air is far colder than the interior air, and there will be a significant change in air temperature once it enters the house, causing condensation to form on the surface of the ducts that run throughout the rooms of the structure to provide fresh air. This condensation has the potential to cause mold, mildew, and other damages within the wall cavities. To prevent this, the design of the Alley House specified insulated ducts to be installed where the outdoor air enters the home and travels to the ERV, as well as insulated ducts for all supply ductwork and for return air ductwork back to the ERV.



ERV Installation

PHOTOVOLTAIC PANEL ARRAY

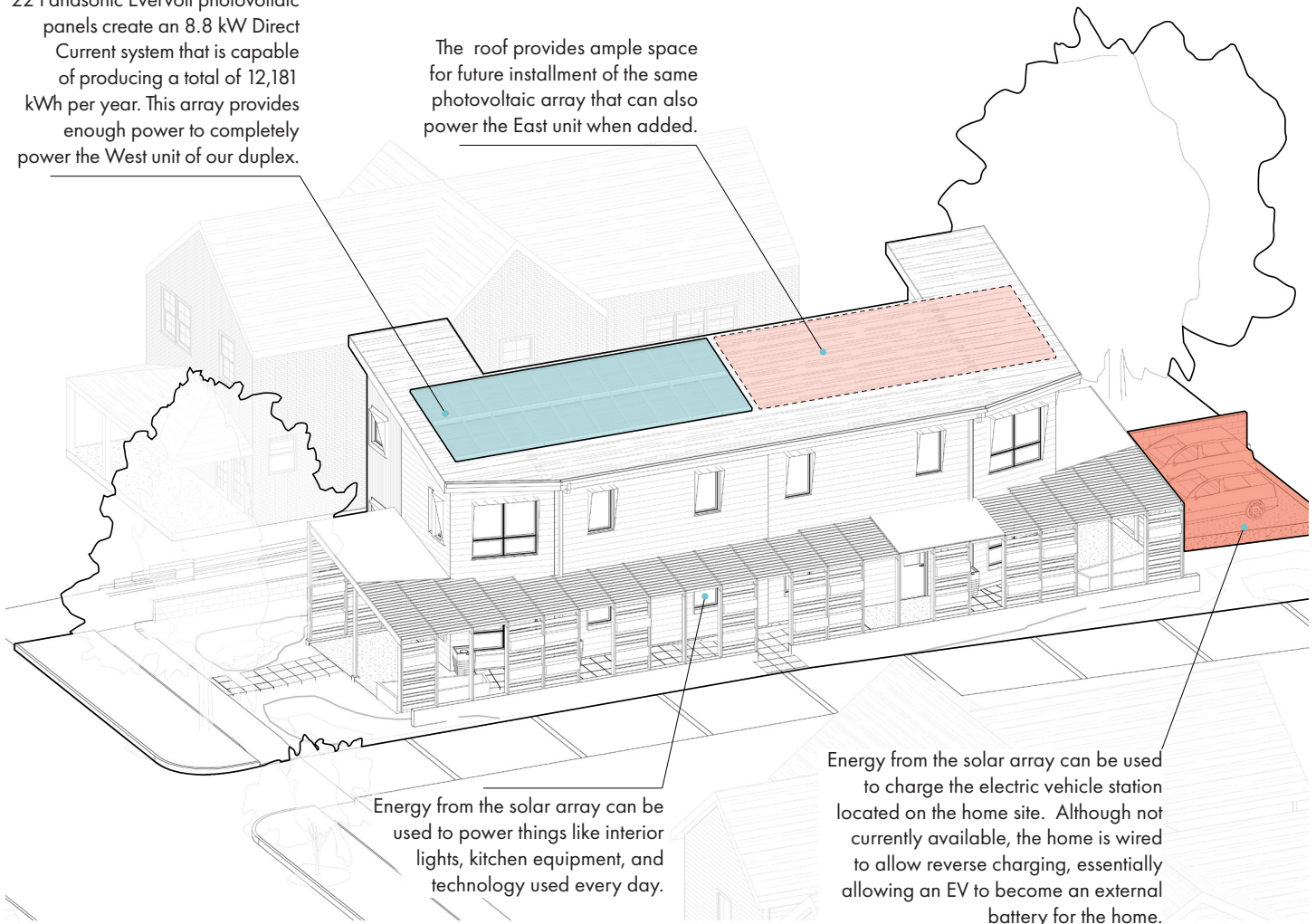
Because modern life is so dependent on technology, Cardinal Studio prioritized a strategy to provide backup power during outages. Additionally, while the Alley House is designed to maximize sustainable passive strategies like cross and stack ventilation, supplementary mechanical heating and cooling is still required to ensure comfort on all days of the year, and these mechanical methods do not function during a power disruption.

As a solution, the Alley House employs an 8.8 kW photovoltaic panel array on the roof that provides sufficient energy to power the entire west unit during a power outage. This energy can be used directly in the house to power important functions including lights, kitchen equipment, the HVAC system, TVs, and computers. This energy also can be used to charge an electric vehicle.

PHOTOVOLTAIC PANELS

22 Panasonic Evervolt photovoltaic panels create an 8.8 kW Direct Current system that is capable of producing a total of 12,181 kWh per year. This array provides enough power to completely power the West unit of our duplex.

The roof provides ample space for future installment of the same photovoltaic array that can also power the East unit when added.



Placement of PV Panels

BATTERY BACKUP

To allow for reliable backup power, the Alley House has a battery backup system that can store enough energy for critical circuits to run for up to one week. The system consists of two EcoFlow DELTA Pro batteries, which can be used together to power a variety of devices, including 240V applications.

The two batteries are connected to each other with the EcoFlow Double Voltage Energy Hub, which allows for a total of 7200W, 240V output. The system is then connected to a 240V receptacle, located near the electrical panel in the mechanical room. This is connected to a breaker that is controlled by a mechanical interlock, which allows either the grid or the EcoFlow system to supply power to the rest of the breakers. In this way, the homeowner can easily switch from grid power to the battery backup during an outage.

The battery backup system can be charged by plugging into any wall outlet. It would be most advantageous to charge the system on sunny days, when the photovoltaic panels are generating the most energy. The units are also portable, and can be charged at car charging stations, which allows for more flexibility in the case of a long-term power disruption.

Each unit has a capacity of 3.6 kWh, a total capacity of 7.2 kWh. It is estimated that a refrigerator can be powered for up to four days, and electric lighting could be powered up to eight days based on this capacity. It can even power an air conditioner up to 7.2 hours when necessary.

The capability to power both heavy loads as needed as well as critical circuits for longer time periods will help the Alley House and its residents respond to power disruptions that are common with Indiana's climate.



Mechanical interlock to toggle between grid and backup power



EcoFlow units placed near 240V outlet that ties into breaker

NATIVE PLANTS

The Alley House's landscape focuses on the interaction of native plants and water management. Native plants ensure that the ecosystem created thrives in the Indianapolis climate. Using native plants in the landscape excludes invasive species that are harmful to the natural ecosystem and helps to maintain water on-site: resilient and drought-resistant plants reduce the amount of water and care needed to maintain the health and beauty of the landscape.

Low-maintenance plants such as Red Twig Dogwood (*Cornus servicea*), Purple Coneflower (*Echinacea purpurea*), and Little Henry Sweetspire (*Itea virginica*) benefit residents by reducing maintenance time and cost as well as reducing the likelihood of replacement.

The plants' longevity creates a sustainable ecosystem that promotes natural diversity by providing food and habitats for a variety of wildlife.



Great Blue Cardinal Flower

(*Lobelia siphilitica*)

Zone: 4 - 9

Mature Height: 24-36"

Mature Width: 10-18"

Bloom Time: Mid to Late Summer

Light: Full Sun and Full Shade



Purple Coneflower

(*Echinacea purpurea*)

Zone: 4 - 9

Mature Height: 24-36"

Mature Width: 18-24"

Bloom Time: Mid Summer

Light: Full Sun



Blueflag Iris

(*Iris versicolor*)

Zone: 3 - 8

Mature Height: 24-36"

Mature Width: 10-18"

Bloom Time: Late Spring

Light: Full and Partial Sun



Little Henry Sweetspire

(*Itea virginica*)

Zone: 5 - 9

Mature Height: 24-36"

Mature Width: 24-36"

Bloom Time: Early Summer

Light: Full Sun and Full Shade

Native Plant Materials

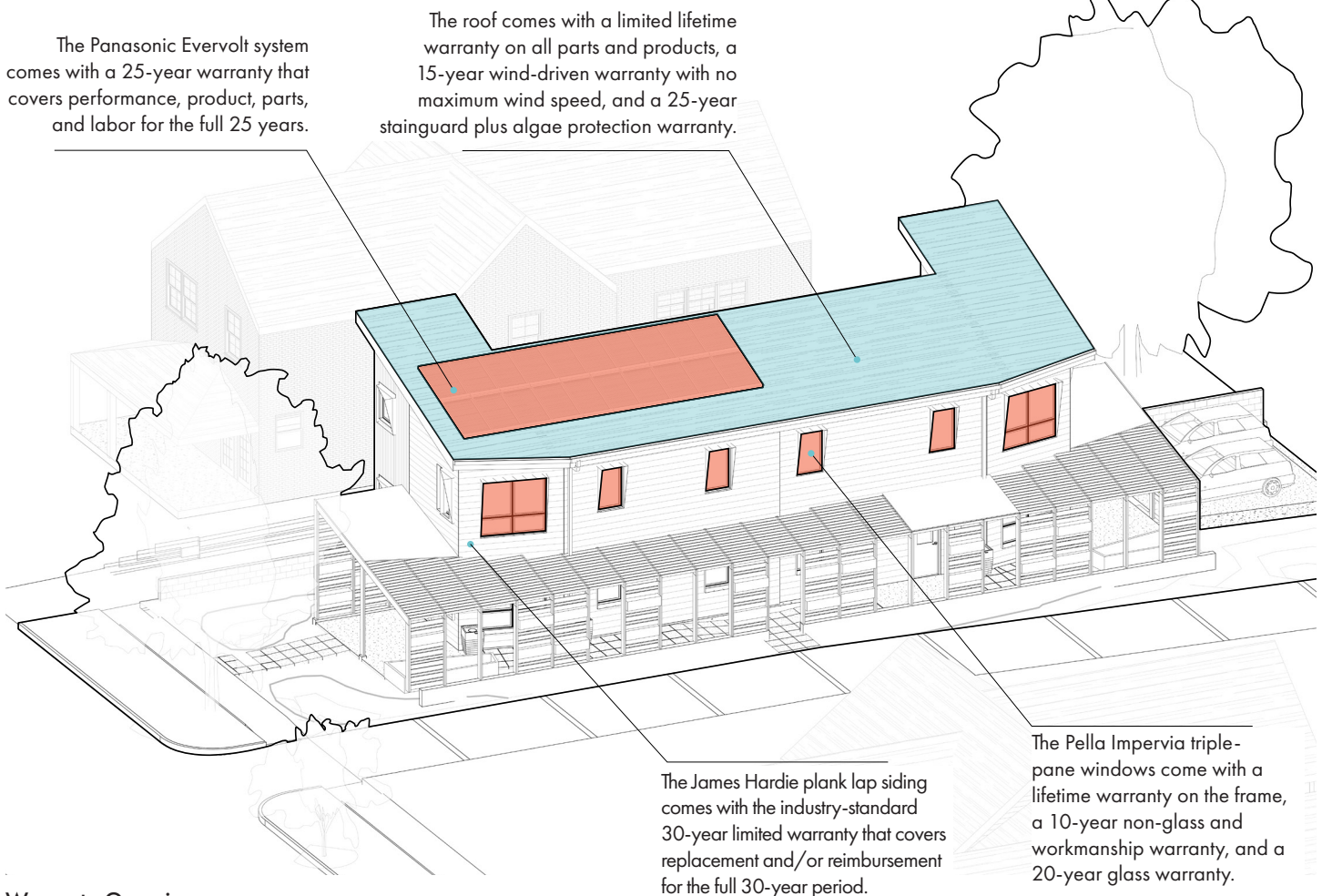
MANUFACTURER'S WARRANTIES

All materials used in the Alley House eventually will require replacement or repair. The unpredictable and often severe weather in Central Indiana often results in damage to structures, trees, and landscapes. After a heavy thunderstorm, tree branches frequently litter lawns and block driveways, and building components such as siding and roofing material are sometimes torn off. Repairs and replacements for such items can become major obstacles for residents who lack funds to immediately hire skilled workers or buy replacement materials.

Not only does unrepaired damage detract from the appearance of the neighborhood around the affected property, but deferring repairs also can lead to more significant problems. Unaddressed exterior damage can cause further damage to components within the exterior wall or contribute to health risks such as formation of mold and mildew.

The Alley House incorporates exterior building materials and interior finishes that include robust industry warranties that offer replacement and cover the cost of labor. This ensures that these costs will not be incurred by the homeowner. It also incorporates the same appliances that are used in other units managed by Englewood CDC, so they can be more easily serviced by technicians familiar with the models.

By removing financial and other maintenance obstacles, building maintenance is more likely to occur, and a properly maintained building is more resilient. Addressing repairs promptly enables homeowners to prevent small problems from becoming larger problems. The protection provided by warranties provide residents with better quality of life, Cardinal Studio's ultimate goal for the Alley House.



Warranty Overview