

Englewood Passive House Duplex

Project Type: Multi-Family Passive House
Project Size: 5,900 sf conditioned (2,950 sf per unit)

Program Summary:

This 2-unit, three story duplex responds to the acoustic and visual challenges of a site near a busy highway by utilizing assembly enclosure, massing, and fenestration practices integral to Passive House standards to create a uniquely comfortable residence. The program addresses the rising need for designed energy efficiency, urban density, and the desire for both privacy and outdoor connection in residential applications. Passive House Certification will be completed in 2023.

Program (per unit):

- Kitchen
- Dining Area
- Living Room
- 3 beds
- 4.5 bath
- Office
- Family Room
- Roof Deck
- Outdoor Patio
- 2 Car Garage

Project Completion Date: September, 2022

Project Location: Englewood, Colorado



Project Narrative

The Englewood Passive House Duplex sets a new standard for high-end low-energy living as the first multi-family Passive House Institute (PHI) certified project in Colorado.

The 2-unit, three story building is situated on a difficult site adjacent to a busy arterial road. Driven by the acoustic and visual challenges of the site, creating a quiet, comfortable, healthy, indoor environment aligned with the Passive House standard. The exclusively electric, high-performance homes achieve both comfort and energy efficiency through an air-tight building envelope, super-insulation, and continuously ventilated indoor air. High performance windows combined with a super durable membrane, sheathing, and insulation keep the home interior peacefully quiet, despite facing a highway.

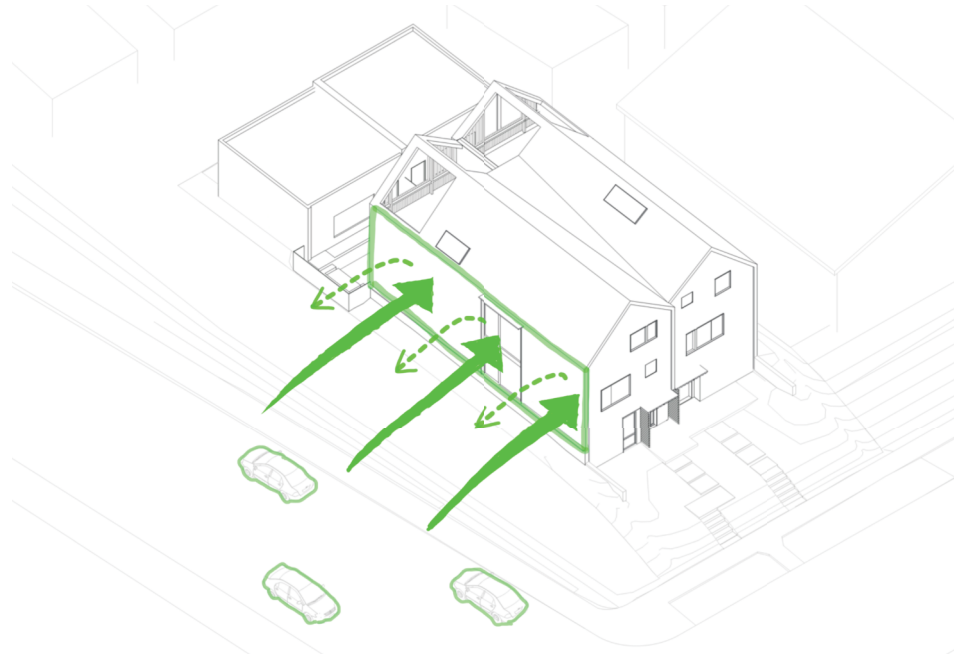
The design features a bank of south-facing, triple-pane windows that optimize passive solar gain and bring daylight into the heart of the home on all three levels, while shutting out sound and air pollution of the adjacent highway. Strategically located skylights provide dramatic daylight and allow privacy for interior spaces. Both units command sweeping views to the Rocky Mountains from the upper stories, most dramatically from a large West-facing balcony that serves as an occupiable extension to a spacious party room on the third floor.

The bold design, with richly-colored wood and metal siding punctuated by large window openings, was the result of a careful and pragmatic design approach which sought to calibrate the home for ideal passive solar while shielding occupants from the busy highway and prioritizing simplicity in order to optimize energy performance.



WELL-BEING

Strategically placed to optimize passive ventilation, operable windows in all habitable spaces allow access to fresh air and daylight. South-facing skylights provide indoor access to the sky, and assist circadian rhythm regulation. The units utilize ERVs to extract stale indoor air, replacing it with filtered fresh air and achieving exceptional IAQ. Each all-electric residence avoids the use of natural gas, thereby reducing pollutants such as NO₂ and CO that lead to respiratory illnesses. Semi-private outdoor spaces provide occupants with sprawling mountain views and contextual connection with surroundings. Despite immediate proximity to US Hwy 85, the air tight and super-insulated envelope dramatically reduces vehicular noise, reinforcing a peaceful home experience.

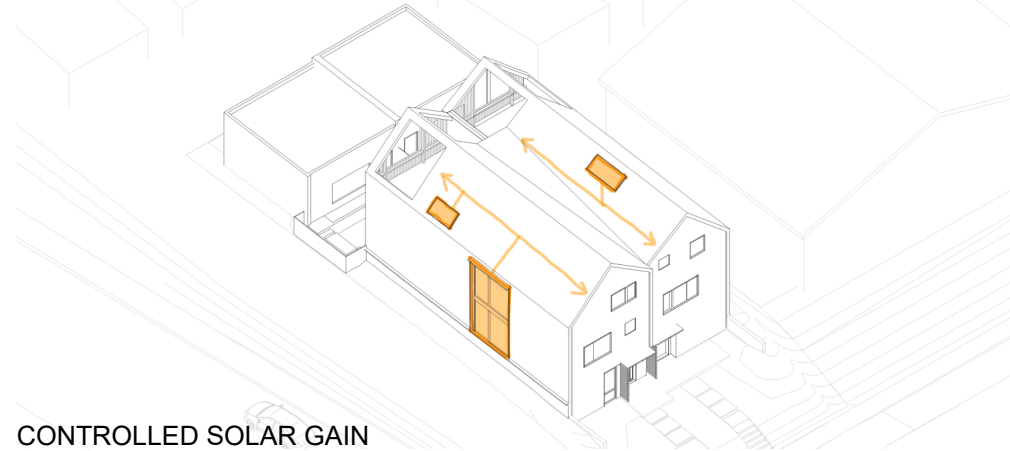


NOISE REDUCTION: The air tight and super-insulated envelope dramatically reduces vehicular noise, reinforcing a peaceful home experience.

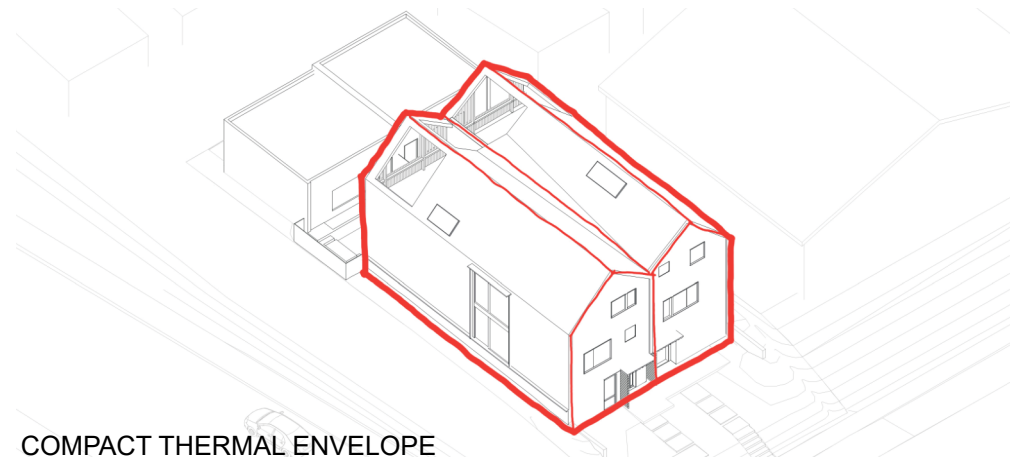


ENERGY

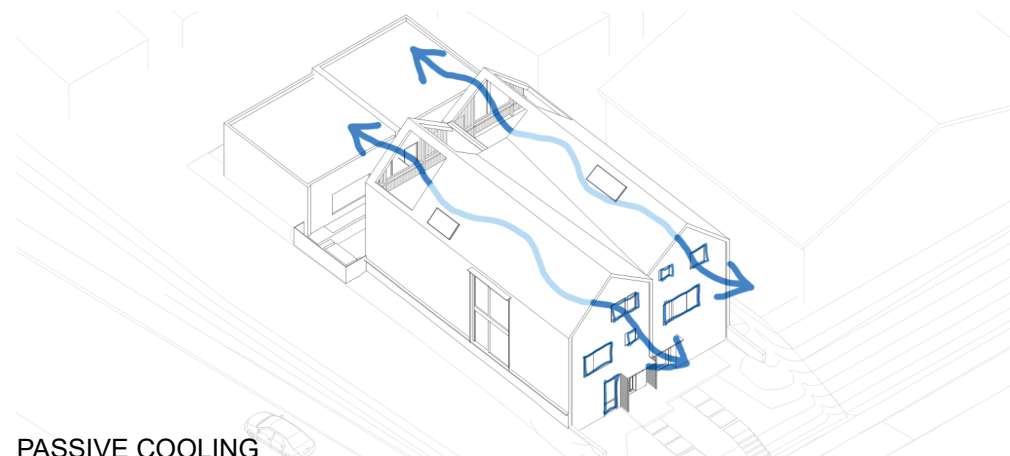
The world's most rigorous standard for energy-efficient buildings, Passive House certification leads to a 90% reduction in heating and cooling compared to typical buildings. Designed from the beginning to be Passive House certified, the fenestration, assemblies, and volume were optimized to reduce energy loads in each residence through iterative collaboration with building performance specialists. Calibrated to Passive House design standards, the envelope performance is further improved by allowing the two units to share mass, resulting in a more efficient surface-to-volume ratio. A central 3-story bank of triple-glazed south facing windows and skylights distributes passive solar warmth and daylight throughout the home. Together with passive cooling strategies, air-tightness values that exceed code, and thermal-bridge free design, a hyper-efficient heat pump and ERV system further reduces overall energy consumption.



CONTROLLED SOLAR GAIN



COMPACT THERMAL ENVELOPE



PASSIVE COOLING

RESOURCES

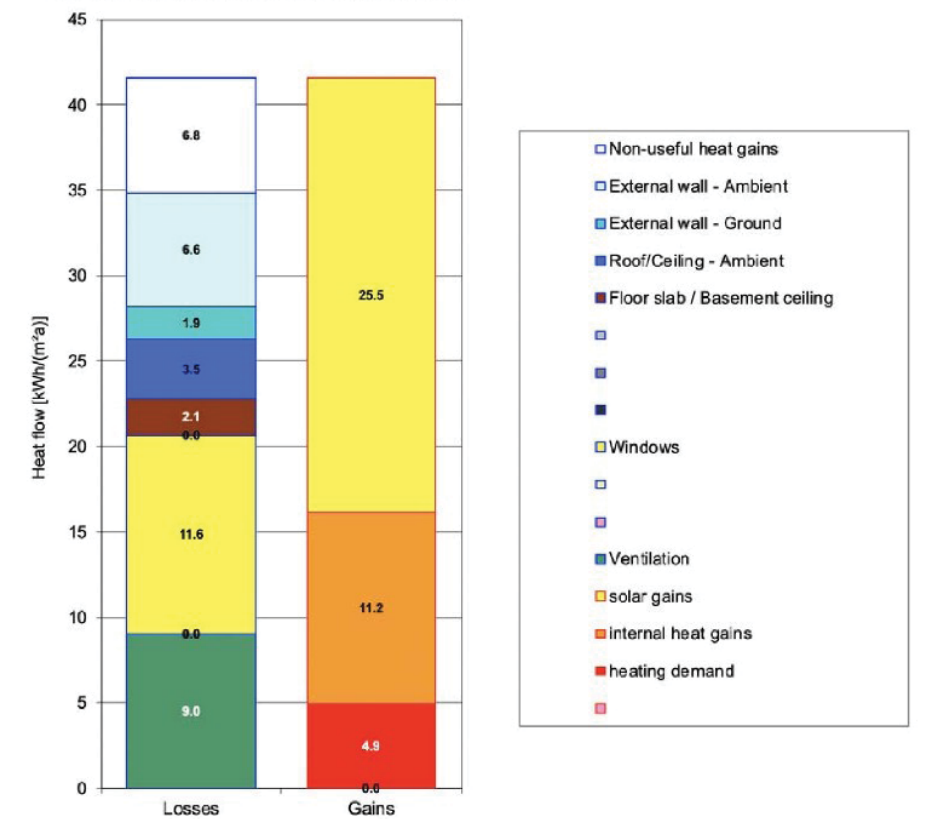
Embodied carbon has been minimized through the following strategies: Instead of a concrete floor slab, a 'slabless slab' was installed: two layers of floor sheathing glued and screwed directly over insulation and a vapor membrane.

All wood construction, with dense-pack insulation as the primary insulating material (with a negative GWP).

Finishes: Real wood flooring and wood siding were used. The high-quality, thermally-modified ash siding is a low-carbon material and will last over 50 years.

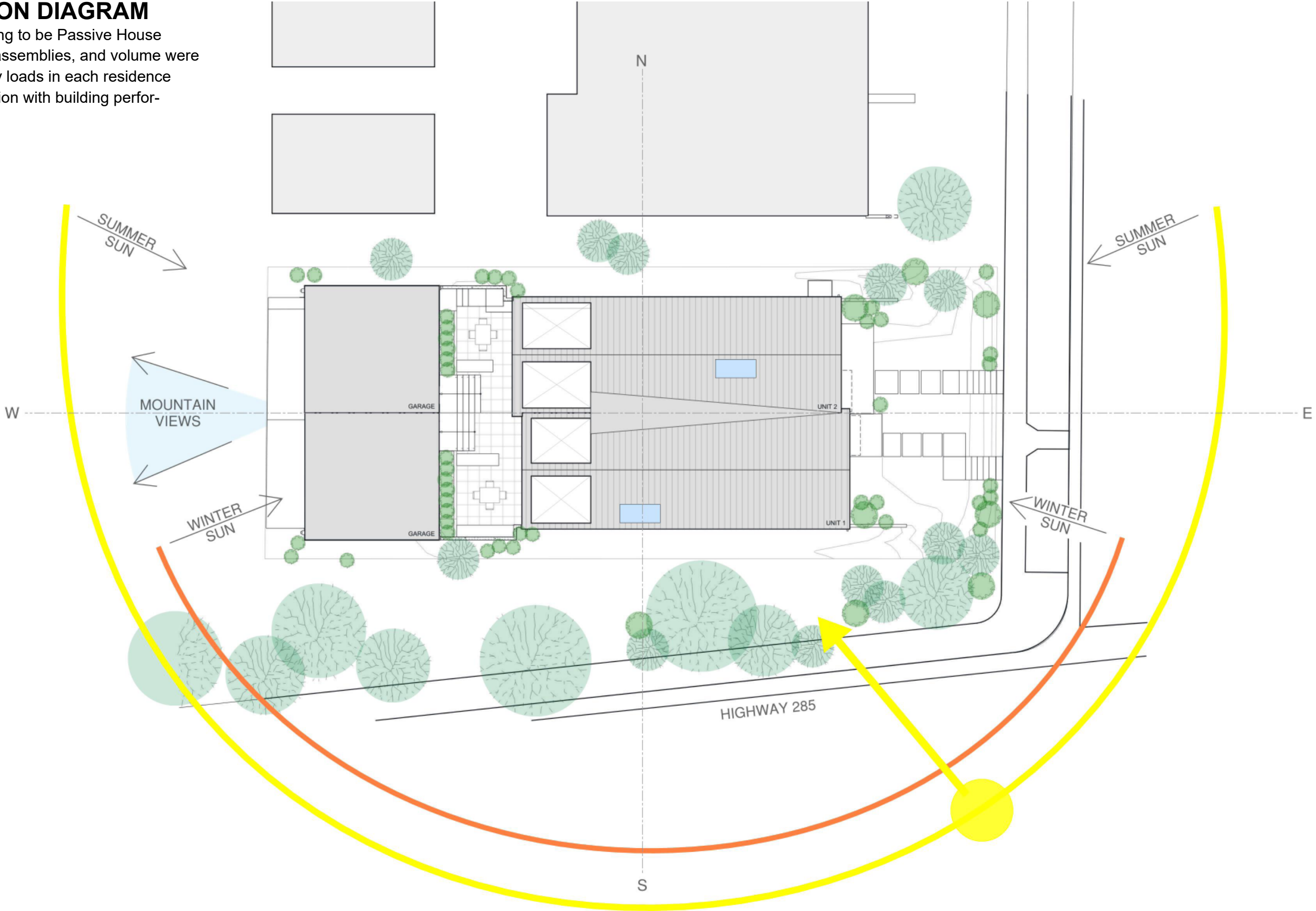
Durability: Passive House detailing avoids condensation and mold risk, combined with vapor-open envelope materials - the building is built to last virtually forever.

Energy balance heating (monthly method)

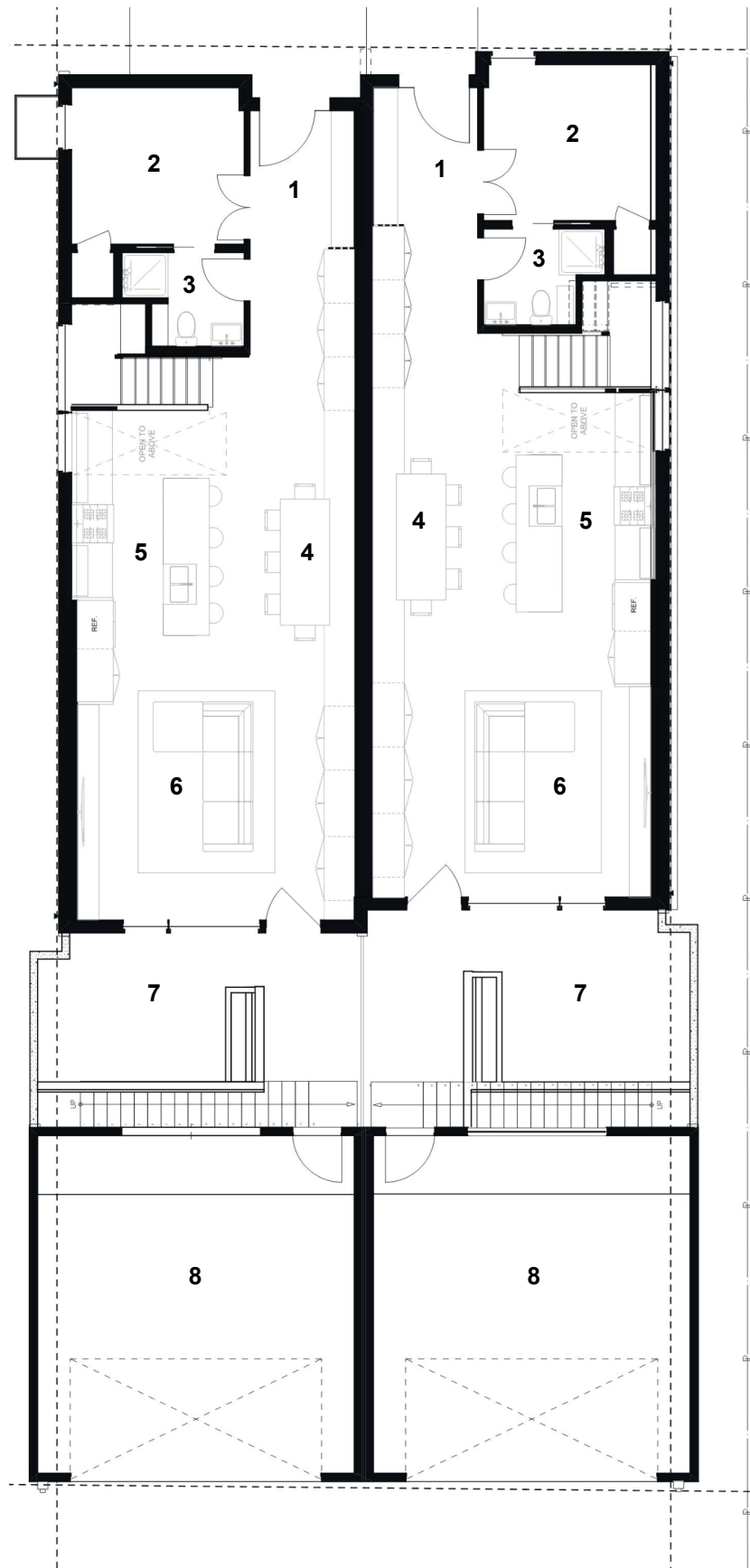


SITE ORIENTATION DIAGRAM

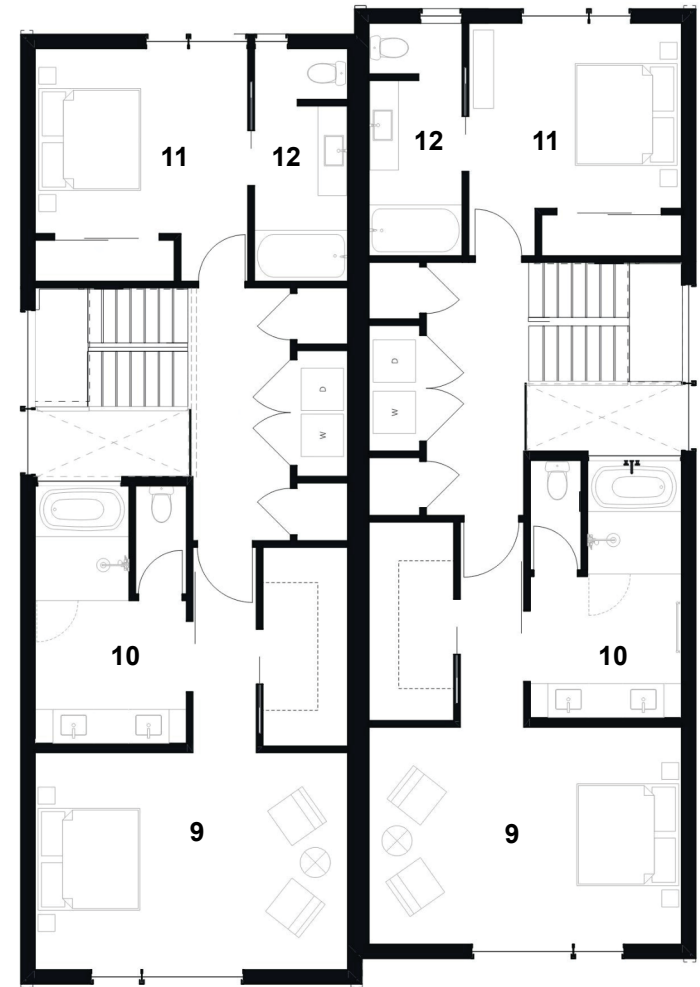
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FIRST FLOOR PLAN



SECOND FLOOR PLAN



THIRD FLOOR PLAN



- | | | |
|------------------|------------------|-----------------------|
| 1 entry | 9 bed 1 | 13 bed 3 |
| 2 office | 10 bath 2 | 14 bath 4 |
| 3 bath 1 | 11 bed 2 | 15 family room |
| 4 dining | 12 bath 3 | 16 powder room |
| 5 kitchen | | 17 roof deck |
| 6 living | | |
| 7 patio | | |
| 8 garage | | |





DESIGN FOR DISCOVERY

This project created an educational opportunity for both the builder and the greater green building community. The construction process coincided with the start of the Marshall Fire Rebuild, a movement aimed at rebuilding a Colorado front range community decimated by fire in 2021. In response to the fire, the local utility, Xcel Energy, decided to offer a \$45,000 rebate for homes rebuilt to Passive House standards, creating significant momentum in the exploration and implementation of Passive House high performance building practices. As a result of this increased interest, the Englewood Duplex builder hosted several informational duplex tours as construction neared completion to share the lessons he learned during his building process. A number of Marshall Fire community members attended these tours to better understand the requirements and benefits of Passive House building, leading to a substantial increase in the number of Passive Houses built in Colorado.

DESIGN FOR CHANGE

As Colorado wildfires become more prevalent, homeowners look for ways to ensure their home protects them from smoke, poor air quality, and flames. While thermally-modified wood siding and corrugated metal offer exterior fire resistance, a combination of electric Energy Recovery Ventilators (ERV) and extreme air tightness values allow Passive House homeowners to keep smoke and pollutants out of the home, thus regaining control of their indoor environment. The use of all-electric units prevents future reliance on gas availability, while significantly reducing the home's ongoing carbon consumption in the age of a climate crisis. By maximizing the value of a single site property, this duplex offers flexible and desirable urban density, and also creates opportunities to accommodate a trend towards generational living seen as a result of rising housing market instability.







The Englewood Passive House Duplex exemplifies the many benefits of a multi-unit construction within a shared Passive House envelope.

By leveraging building science to maximize and enhance natural light, the construction places a focus on health and comfort.

