Passive House Construction

with Fiberglass & Mineral Wool Insulation

Insulation Institute™

KNOWLEDGE. LEADERSHIP. CONFIDENCE.

What is a Passive House?

According to the Passive House Institute U.S. (PHIUS), passive building is a set of design principles used to attain a quantifiable and rigorous level of energy efficiency within a specific, quantifiable comfort level.

Passive House construction optimizes “gains and losses” based on the climate of the building and are built with five guiding principles:

01

Use of continuous insulation throughout the entire envelope with no thermal bridging.

02

Extremely airtight construction, preventing infiltration of outside air and loss of conditioned air.

03

High-performance windows (either double or triple-paned windows depending on climate and building type) and doors that use the sun’s energy for the heating season.

04

Use some form of balanced heat and moisture recovery ventilation.

05

Requires smaller HVAC systems due to higher levels of insulation.

The Benefits of a Passive House

There are four primary benefits of Passive House construction, including:

Reduced Energy Costs

It's the least energy intensive in terms of home energy efficiency. Passive buildings perform up to 85% better than conventional buildings in terms of energy efficiency.[1]

Passive Survivability

It's the best construction for sheltering-in-place. In the event of a power failure, a passive house will keep your home comfortable for longer, whether in warm weather or cold climates.

Lower Carbon Emissions

Because passive houses require less energy, these homes reduce carbon emissions, thus making them align with greenhouse gas reduction goals.

More Resilient Construction

The comprehensive approach to design and construction, with airtight, water-resistive construction, means you're going to get a home that is more resilient and better able to withstand the elements.

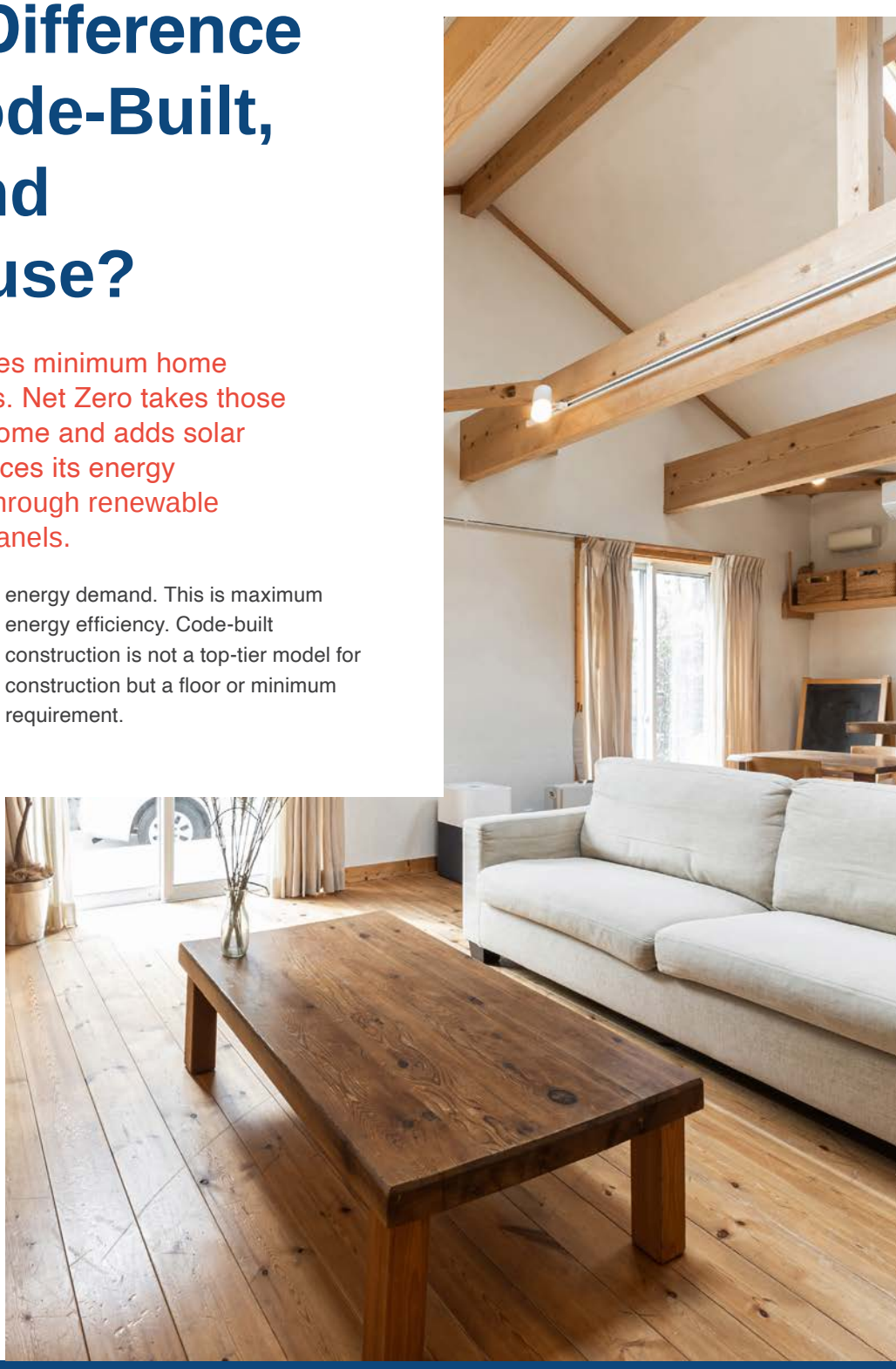
[1] https://www.phius.org/passive-building/what-passive-building/passive-building-faqs

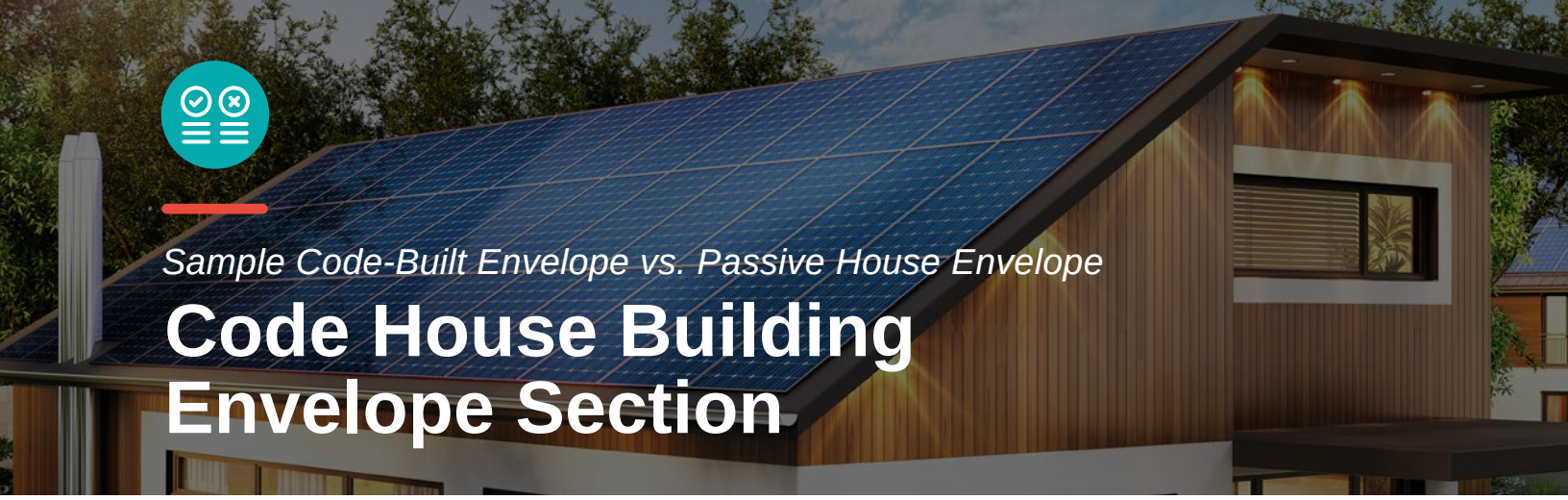
What's the Difference Between Code-Built, Net Zero, and Passive House?

Code-built construction provides minimum home energy efficiency requirements. Net Zero takes those requirements of a code-built home and adds solar panels so that the home balances its energy needs with energy produced through renewable energy such as photovoltaic panels.

Passive House maximizes thermal envelope construction so that the building requires far less energy. With an airtight thermal envelope, the demand for heating and cooling is dramatically reduced, so the HVAC system needed for the home is also reduced, which dramatically reduces its energy demands.

The first rule of energy optimization is to use less energy. Passive House achieves that goal by super-insulating the thermal envelope, making it airtight, and reducing energy demand. This is maximum energy efficiency. Code-built construction is not a top-tier model for construction but a floor or minimum requirement.





Sample Code-Built Envelope vs. Passive House Envelope

Code House Building Envelope Section

Colorado - Climate Zone 5
Roof Assembly - R-49

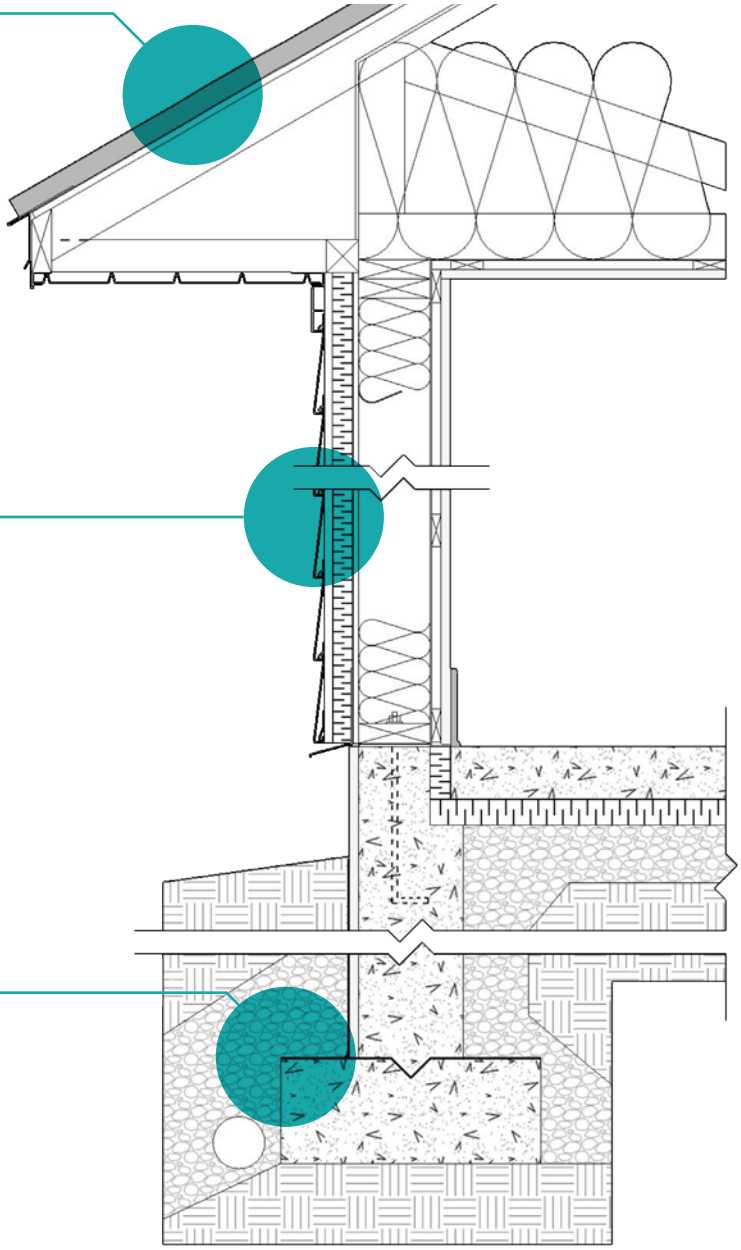
- Gypsum drywall interior finish
- Pre-engineered roof trusses with blown-in fiberglass insulation
- Attic ventilation baffles at soffit and under roof deck
- OSB roof sheathing with self-adhered ice and water membrane
- Drip edge perimeter flashing
- Steel-rib 24 gauge roof panels

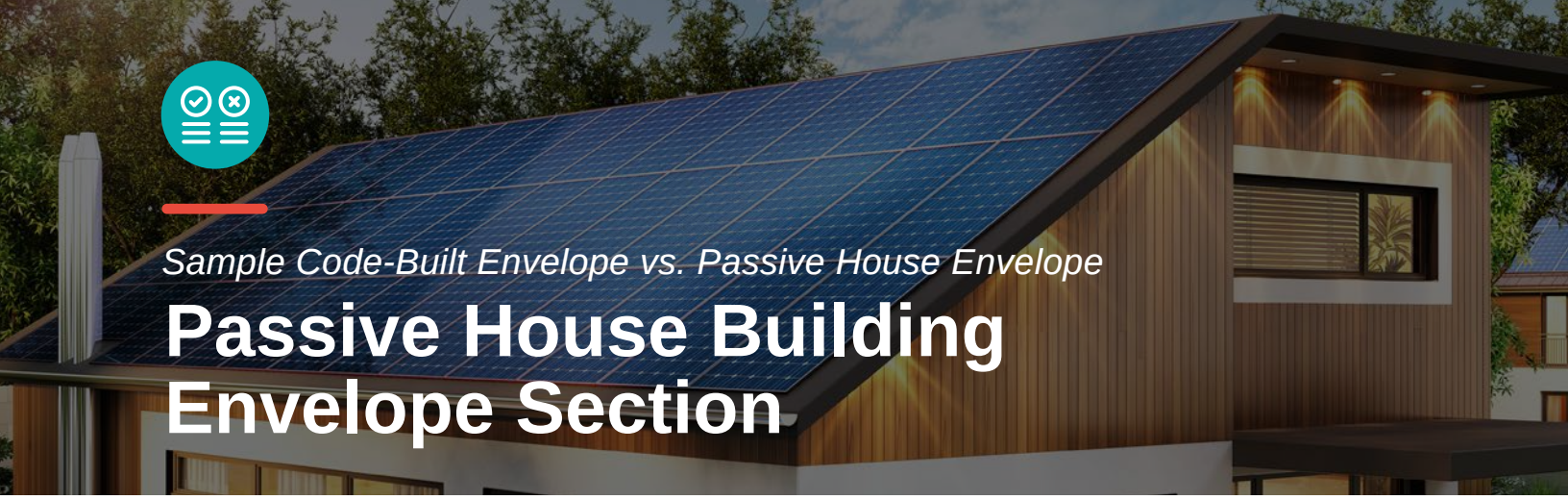
Wall Assembly - R-20 or R-13 + R-5 continuous insulation

- Gypsum drywall interior finish
- 2x4 @ 16" o.c. SPF Stud wall with fiberglass batt insulation
- OSB wall sheathing with weather-resistive barrier, seams / overlaps taped
- Rigid insulation board, continuous on exterior wall
- 7” exposure vinyl cladding, starter and frieze
- Steel wall base flashing

Foundation

- 4" poured concrete slab insulated with R-10 foundation insulation
- Polyethylene vapor barrier
- 4” clean gravel for drainage layer
- Poured concrete foundation footing & foundation wall with 1/2 diameter rebar
- Parging layer with bituminous damp-proofing layer
- Exterior weeping tile





Sample Code-Built Envelope vs. Passive House Envelope

Passive House Building Envelope Section

Roof Assembly - R-80

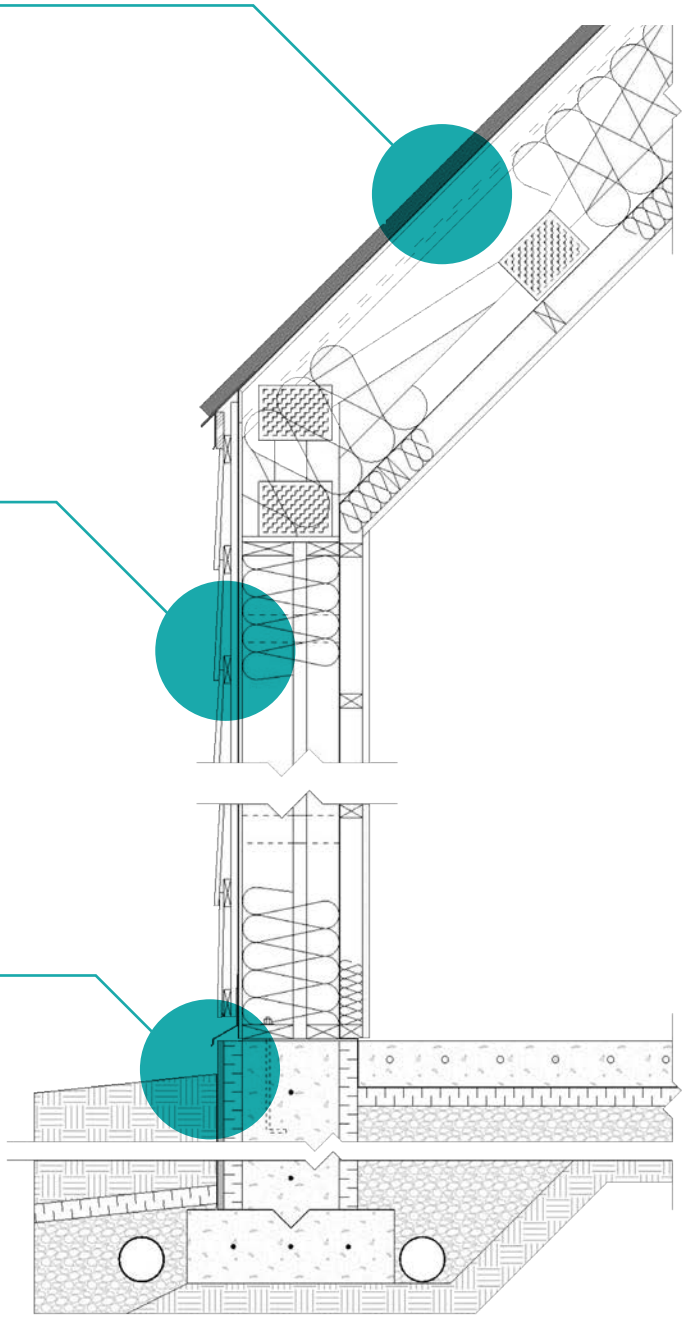
- Gypsum drywall interior finish
- 2x4 service cavity, edge laid, horizontally framed @ 24” o.c. with fiberglass batt insulation
- Intelligent air and vapor control layer covered with tape at all seams
- 2x4 raised heel web truss, cathedral ceiling type with dense pack fiberglass insulation
- 2x2 ledger strips attached to inside of truss top chord with OSB baffle for truss ventilation
- OSB roof sheathing with fully adhered roof membrane
- Siding vent strip at wall-roof intersection for ventilation
- Perimeter drip edge perimeter flashing
- Steel-rib 24 gauge roof panels

Wall Assembly - R-50

- Gypsum drywall interior finish
- 2x3 service cavity, edge laid, horizontally framed @ 24” o.c. with fiberglass batt insulation
- Intelligent air and vapor control layer covered with tape at all seams
- Double LSL stud wall - 2x4 interior + 1 1/2” air space + 2x6 exterior with dense pack fiberglass
- OSB with weather-resistive barrier and taped seams
- 1x4 vertical wood furring strips @ 24” o.c. (rainscreen)
- 1x4 horizontal wood furring strips @ 12” o.c.
- 24" exposure bark siding
- Steel wall base flashing

Foundation

- 5” poured concrete slab with radiant in-floor heating / cooling (geothermal heat pump)
- Vapor barrier
- EPS under slab insulation
- 4" clean gravel drainage layer
- Poured concrete foundation footing & foundation wall with 1/2 diameter rebar, expanded polystyrene insulation interior and exterior of foundation wall
- Parging layer covered with metal flashing
- Expanded polystyrene insulation skirt on perimeter



Passive house. Dynamic performance.

In recent years, Passive House construction has grown in popularity in the U.S. due to its resiliency to extreme weather events, **up to 85 percent lower energy costs, durability and the comfort and high quality fresh air provides.**[2] While mineral wool has long been a popular choice in Passive House construction, many builders don't know they can also use fiberglass insulation.

There are a myriad of benefits to using both fiberglass and mineral wool insulation products in Passive House construction, including their cost-effectiveness, fire performance, and sustainability profiles. This case study provides an example of a Passive House construction project that utilizes fiberglass and mineral wool insulation in its thermal envelope approach.

[2] https://www.phius.org/passive-building/what-passive-building/passive-building-faqs

Case Study: A Modern “Millhaus”

Architect Greg D. Fisher built a modern home influenced by the character of a former cherry mill located on the site. His Fort Collins, Colorado home achieved 0.44 ACH50 airtightness using his strategic approach to creating a thermal envelope designed to keep bulk water and water vapor out while keeping the conditioned air in.

Fisher’s plan for insulating and air sealing the home included aggressive control of thermal bridging, application of air sealing products, and using multiple fiberglass insulation products–including batts and blown-in fiberglass insulation in the wall cavities and attic.

The architect also used mineral wool insulation in many of the cavities that had to be concealed before the home was weather-tight so that the cavities did not remain uninsulated and were not damaged by moisture during construction.

Builder/Architect
Greg D. Fisher, Architect

Location
Fort Collins, CO

Square Footage
3,254

Energy Recovery Ventilation
450 ERV

Insulation/Air Sealing
Blown-in fiberglass/membranes and tapes

Air Tightness
0.44 ACH50

Modeled Performance
13.9KWH/m2a heating demand and 12KWh/m2A cooling demand

Cost
$1M Construction (General contracting, framing & air sealing self-performed at no expense)

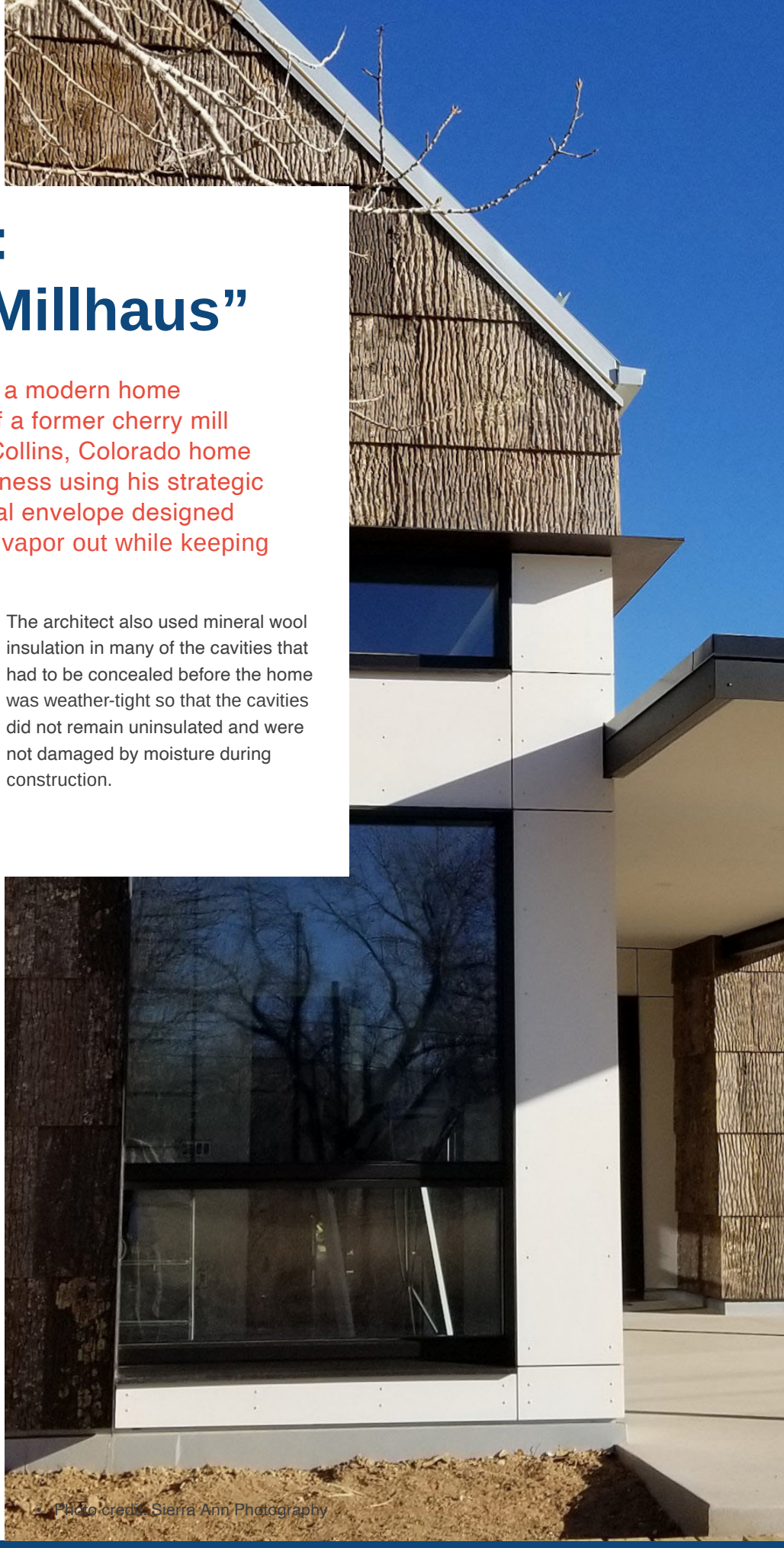


Photo credit: Sierra Ann Photography

Case Study: A Modern Millhaus

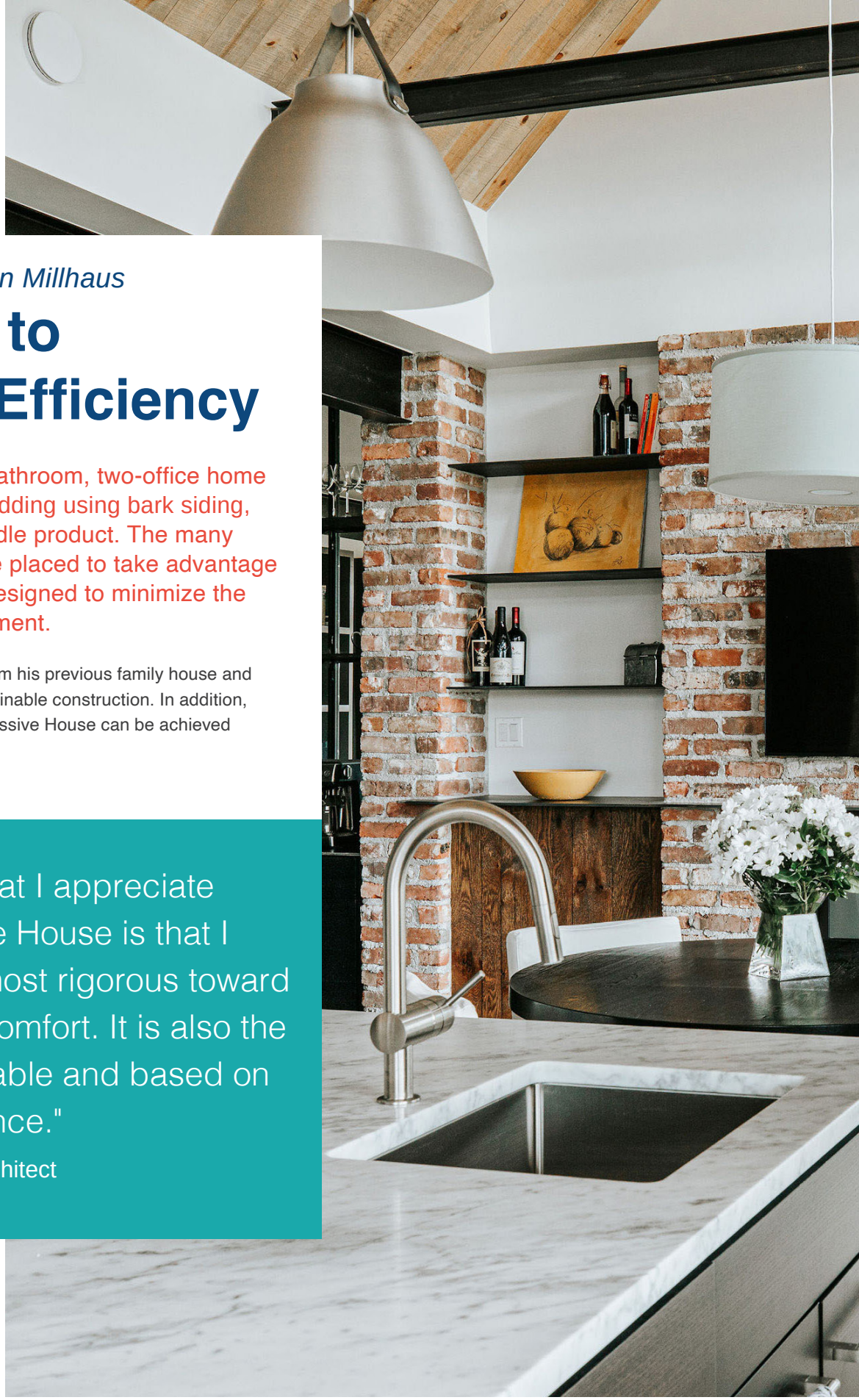
Insulation and Air Sealing Details

The total R-value of the walls is R-50.

The wall assembly includes 2 x 6 exterior framing with a 1 1/2" gap to a 2 x 4 interior wall filled with blown-in fiberglass insulation. Then an intelligent air and vapor control and a 2 x 3 framed service cavity filled with R-13 fiberglass batt insulation.

The airtight envelope also reduces heating and cooling bills*, the size of the HVAC equipment needed, and the size of the photovoltaic solar array needed to achieve Net Zero for the home.

* Savings vary. Find out why in the seller's fact sheet on R-values. Higher R-values mean greater insulating power.



Case Study: A Modern Millhaus

Designed to Optimize Efficiency

The two-bedroom, two-bathroom, two-office home has a unique exterior cladding using bark siding, a complete cradle-to-cradle product. The many windows of the home are placed to take advantage of passive solar gains, designed to minimize the load on the HVAC equipment.

Fisher's goal was to downsize from his previous family house and promote high-performance, sustainable construction. In addition, he sought to demonstrate that Passive House can be achieved beautifully, not just technically.

> "...The thing that I appreciate about Passive House is that I feel it is the most rigorous toward energy and comfort. It is also the most quantifiable and based on building science."
>
> – Greg D. Fisher, Architect

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NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials. Through the Insulation Institute™, we leverage the collective insulation expertise of our organization and our members to empower homeowners and professionals to make informed insulation choices. Our mission is to enable a more comfortable, energy-efficient and sustainable future through insulation — and we are constantly working with building professionals, homeowners, government agencies, and public interest, energy and environmental groups to realize that vision.

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