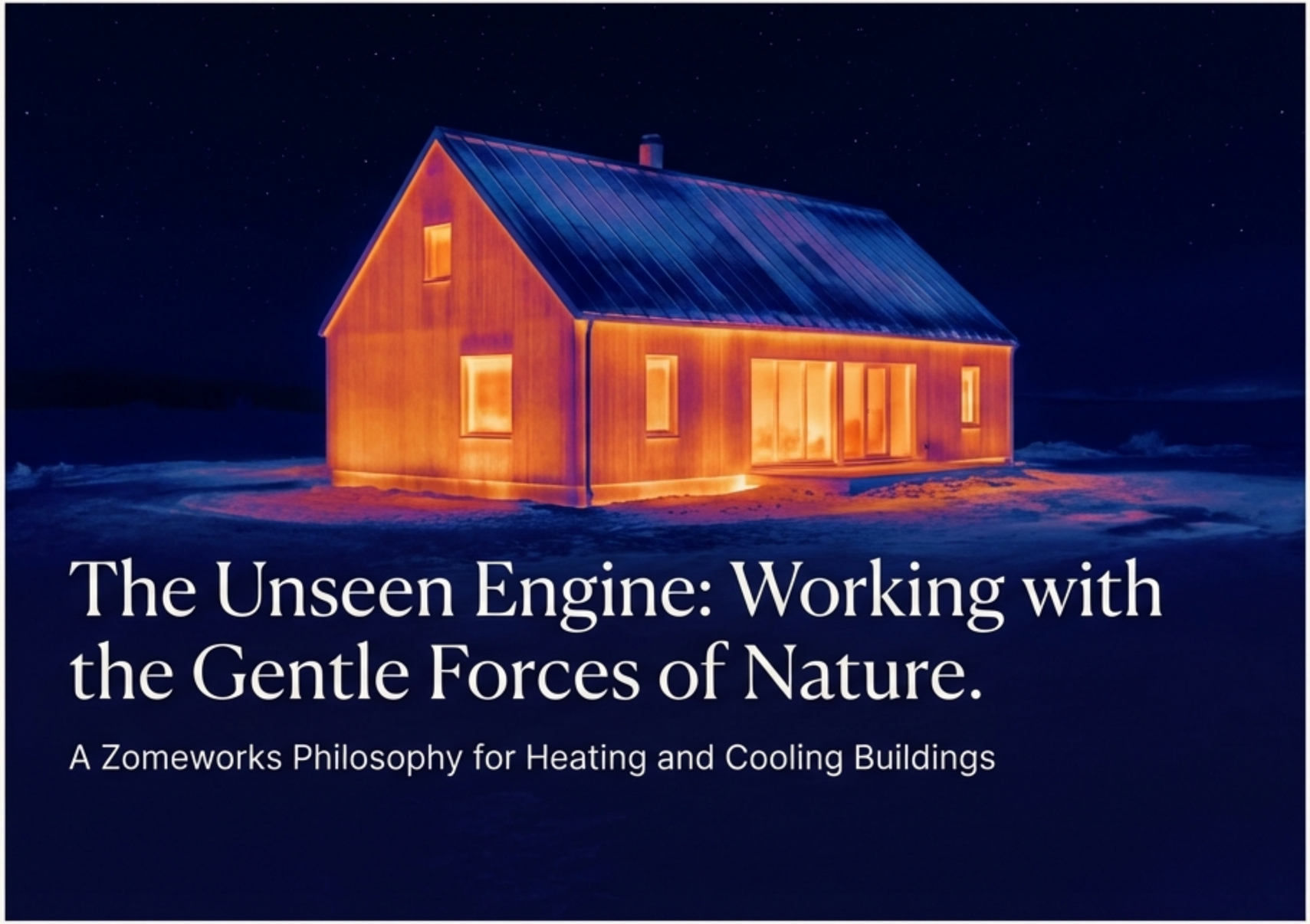


The Unseen Engine: Working with the Gentle Forces of Nature.

A Zomeworks Philosophy for Heating and Cooling Buildings

Zomeworks

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We Are Blinded by the Sun and Misled by the Thermometer.





Our perception of thermal comfort is dominated by two things: the powerful, obvious heat of the sun, and the number on the thermostat. **But this ignores the subtle, constant, and powerful flows of heat that truly govern our environment.**

Our eyes see reflected light, which tells us about shape and color, but “nothing of all important temperature.”

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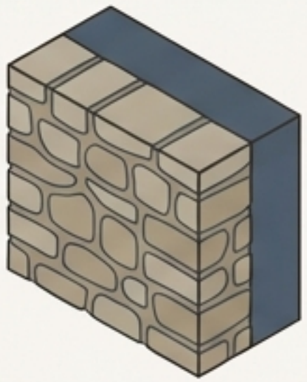
If Our Eyes Could See in Infrared, the Mysteries of Cooling Would Disappear.



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Modern Buildings are Lightweight Shells, Untethered from the Earth's Rhythm.

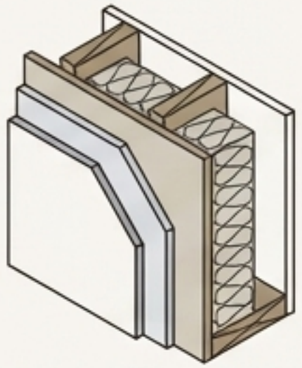
> Heat storage is urgent today because we have gotten so good at constructing lightweight well-insulated efficient buildings that their **one deficiency, lack of thermal mass, becomes apparent.**



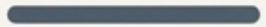
Traditional Masonry Construction



High Thermal Mass



Modern Lightweight Construction



Low Thermal Mass

Traditional masonry buildings had inherent thermal mass, absorbing heat during the day and releasing it at night. Today's high-performance buildings, for all their efficiency, lack this thermal flywheel. They are vulnerable to temperature swings swings and reliant on constant mechanical intervention. To work with nature, we must re-integrate storage.

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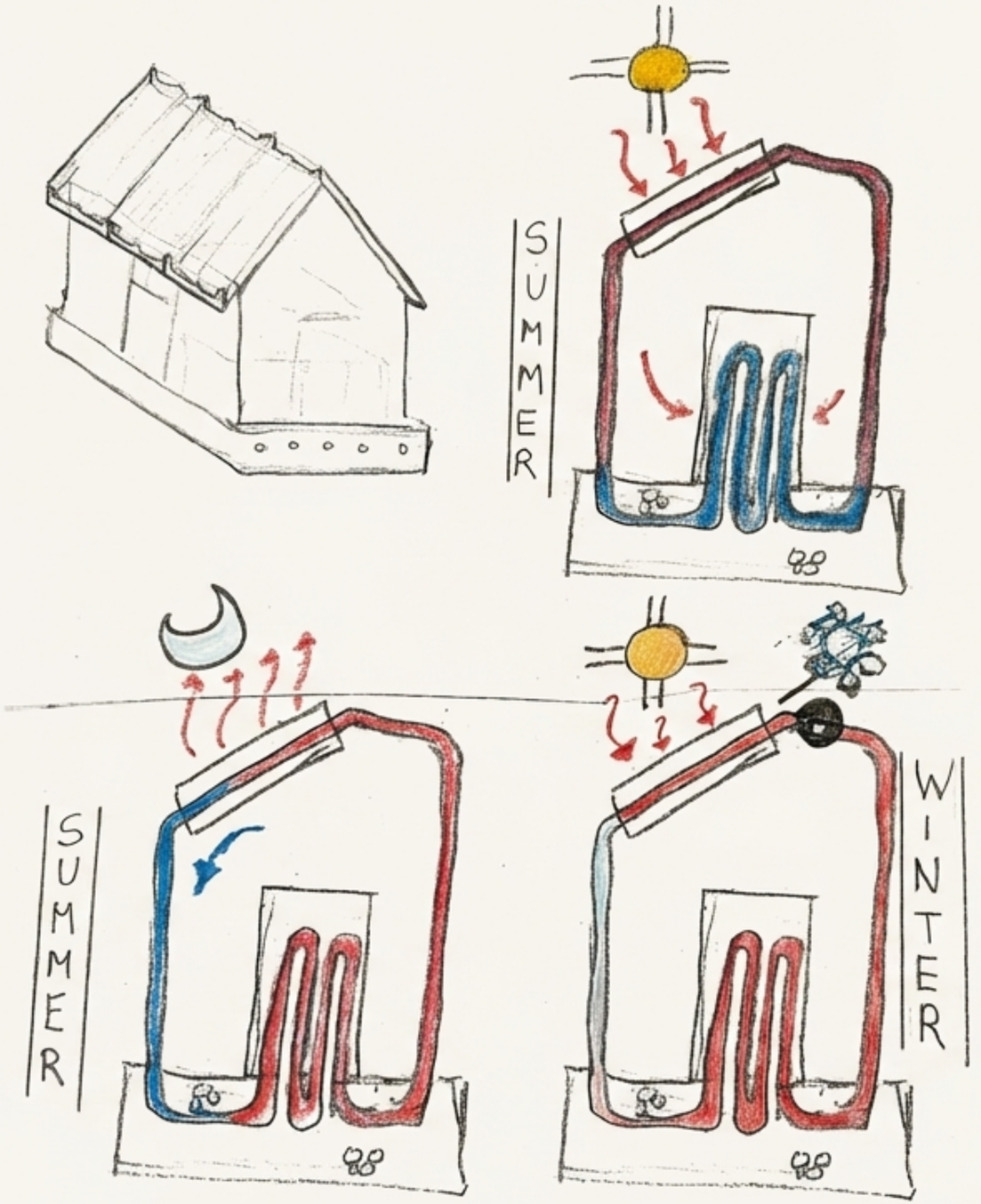
The Di-Thermal Roof: A System that Breathes with the Day and Night.

The Zomeworks approach combines three key elements into one integrated system:

1. **A Collector/Radiator Roof**
   Gathers heat on a winter day, rejects heat on a summer night.

2. **Thermal Storage**
   A “flywheel” of water to store heat or “coolth.”

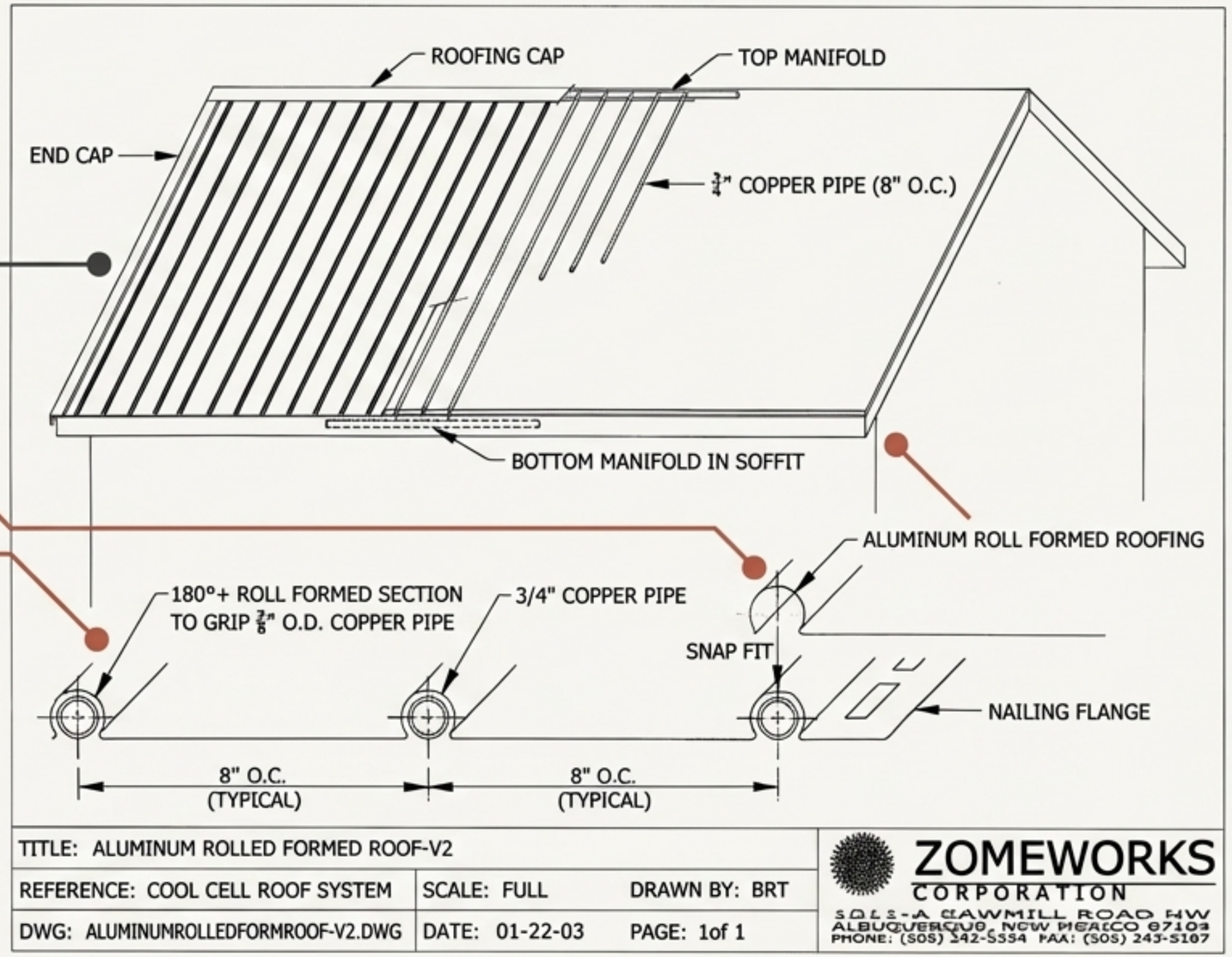
3. **Radiant Interior**
   A silent, comfortable way to deliver that stored energy to the occupants.



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The Engine: An Unglazed Radiator and Solar Absorber in One.

The Di-Thermal roof is the heart of the system. It is constructed from materials like aluminum extrusions with snap-in copper pipes or blow-molded plastics. This design allows it to efficiently absorb solar radiation and, just as importantly, radiate thermal energy to the night sky. It is a roof that performs double duty.



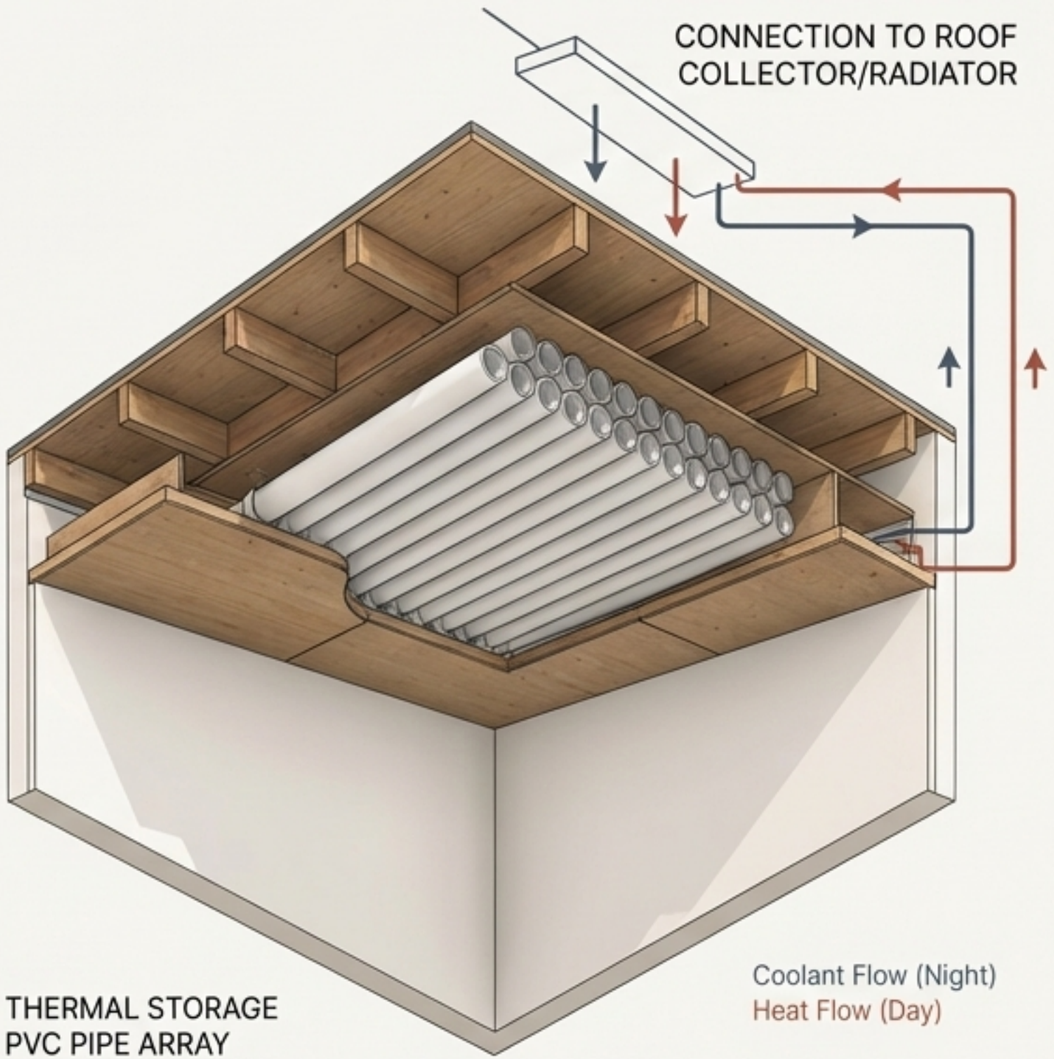
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The Flywheel: Storing Summer Nights for Hot Afternoons

Key Concept: “Store enough heat when the sun shines to get through the cold night or during summer store enough coolth during the night to stay cool during the hot afternoon.”

Water is a perfectly satisfactory thermal storage medium. It is dense, cheap, and safe. Storage can be integrated into the building structure using tanks or arrays of PVC pipes in ceilings and walls.

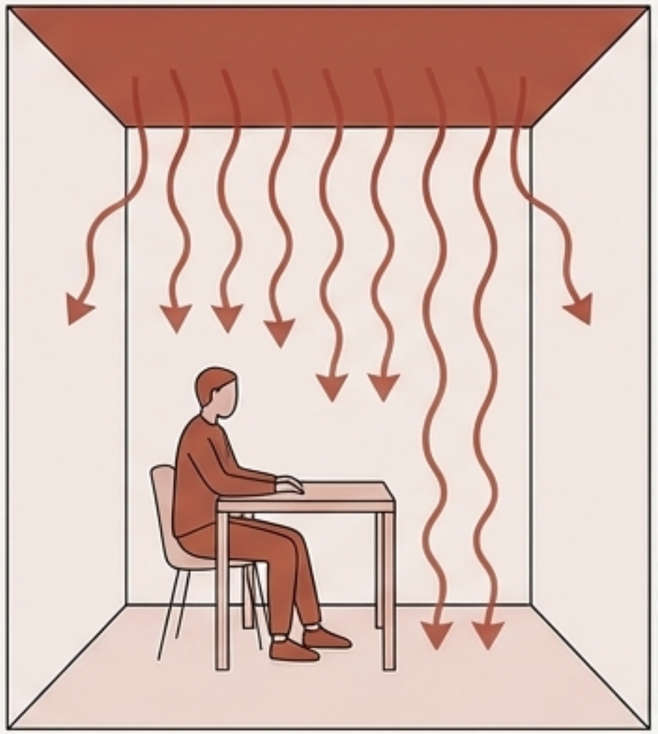
Capacity Example: **3 gallons** of water per sq. ft. of floor can absorb the heat from people, lights, and appliances (~250 BTUs/sq ft) with only a **10°F** temperature rise.



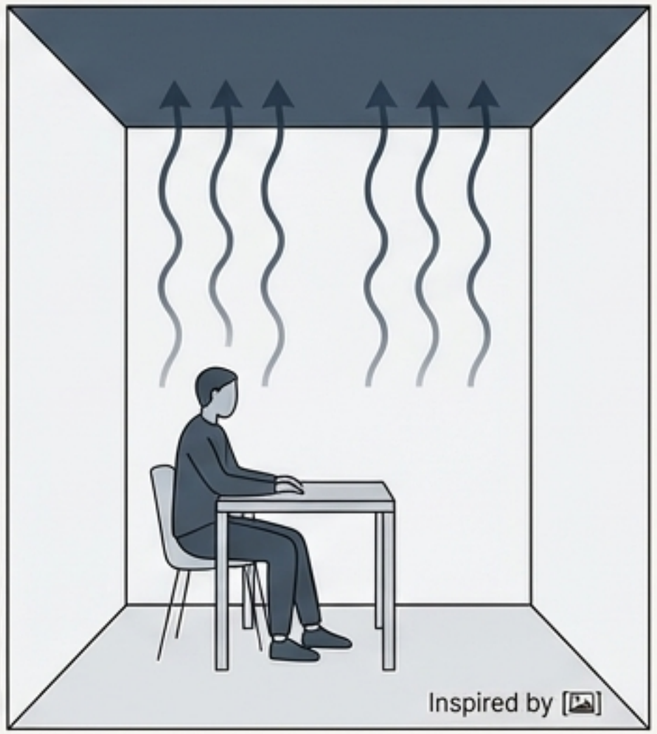
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The New Comfort is Radiant, Not Convective.

The most comfortable form of heating and cooling is radiant. Unlike forced air systems that heat the air, radiant systems heat and cool the surfaces around you—and you. Ceilings are the ideal surface for this exchange.



Winter: Radiant Heating



Summer: Radiant Cooling

"Ceiling systems have few of [the] problems [of floor systems]. They can run at high temperatures because people seldom come in contact with ceilings. Tearing down a plaster ceiling for repairs is much easier than tearing up a concrete floor..."

– Ed Allen, *How Buildings Work*

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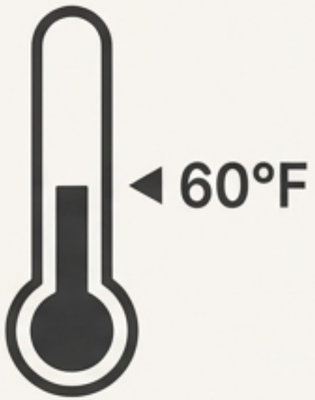
Simple Control, Dramatic Results: The “Andy Shack” Experiment

Control is achieved through simple, passive, and silent overhead shutters. A test building in March ’01 demonstrated the power of this system, showing the room remained stable with shutters closed, then quickly jumped 15-20°F as radiant heat flooded the space once they were opened.



Shutters Closed

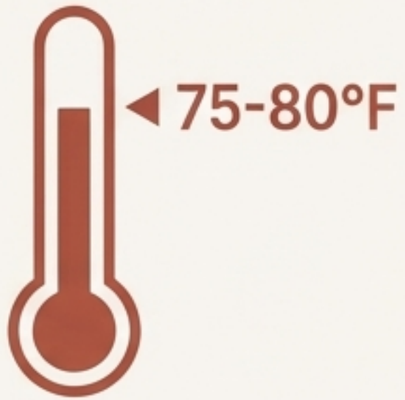
Outside: 45°F
Storage Pipes: 90°F





Shutters Open

Outside: 45°F
Storage Pipes: 90°F



"Overhead bare aluminum shutters are very effective for controlling heat flow... Heat flows 4 or 5 times as readily when open, as closed."

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The Economics of Working with Nature

Annual Heating Savings

40,000 to 100,000 BTUs / sq. ft.

Value: $1.20 to $3.00 / sq. ft. (vs. electric @ $0.10/kWh)

Annual Cooling Savings

~2 kWh / sq. ft.

Value: $0.20 / sq. ft.

The Real Prize in Cooling

Replaces the capital cost of a compressor.

Radiant Cooling Power

60,000 BTUs / 400 sq. ft.

Equivalent to a 1-ton AC unit running for 5 hours.

Construction Cost Target

Cost of regular roof + $3.00 / sq. ft.

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Two Paths to Comfort: Brute Force vs. Elegant Integration.

Brute Force HVAC



Mechanical
Noisy
Drafts
Complex
Energy Intensive
Fights Nature

Di-Thermal Design

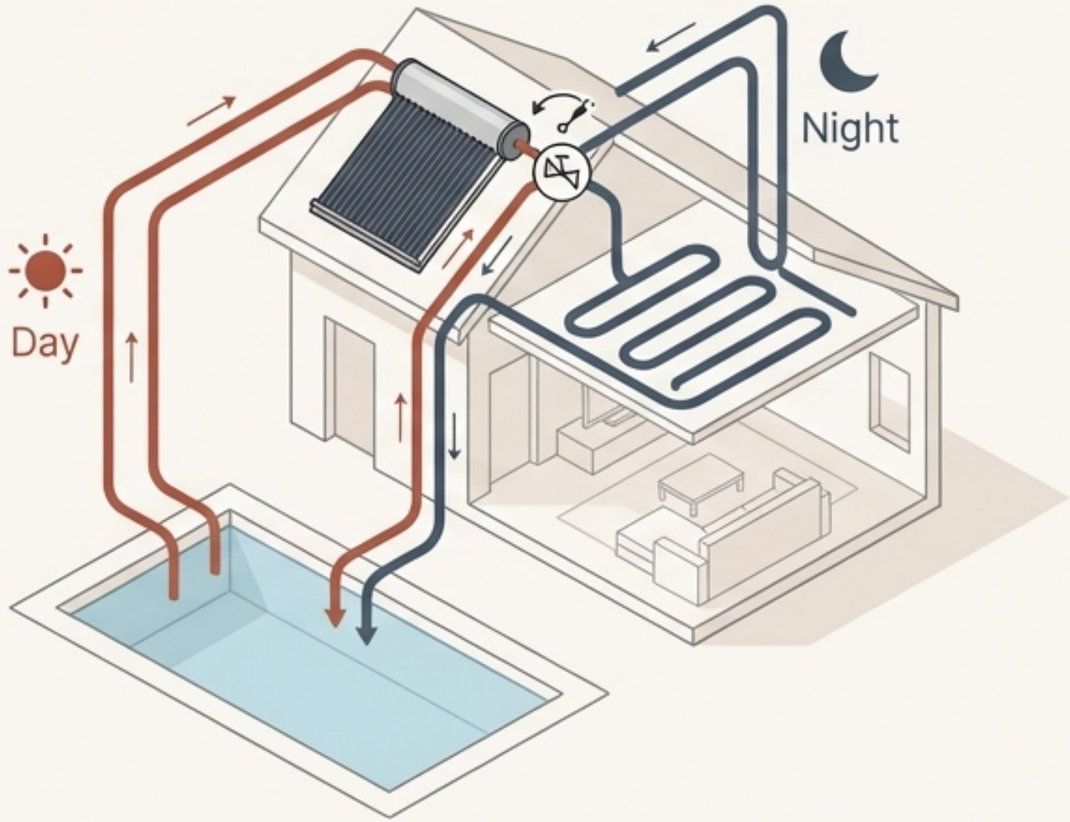


Passive
Silent
Radiant
Simple
Energy Harvesting
Works with Nature

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A Bridge to a New Idea: Cooling with What's Already There.

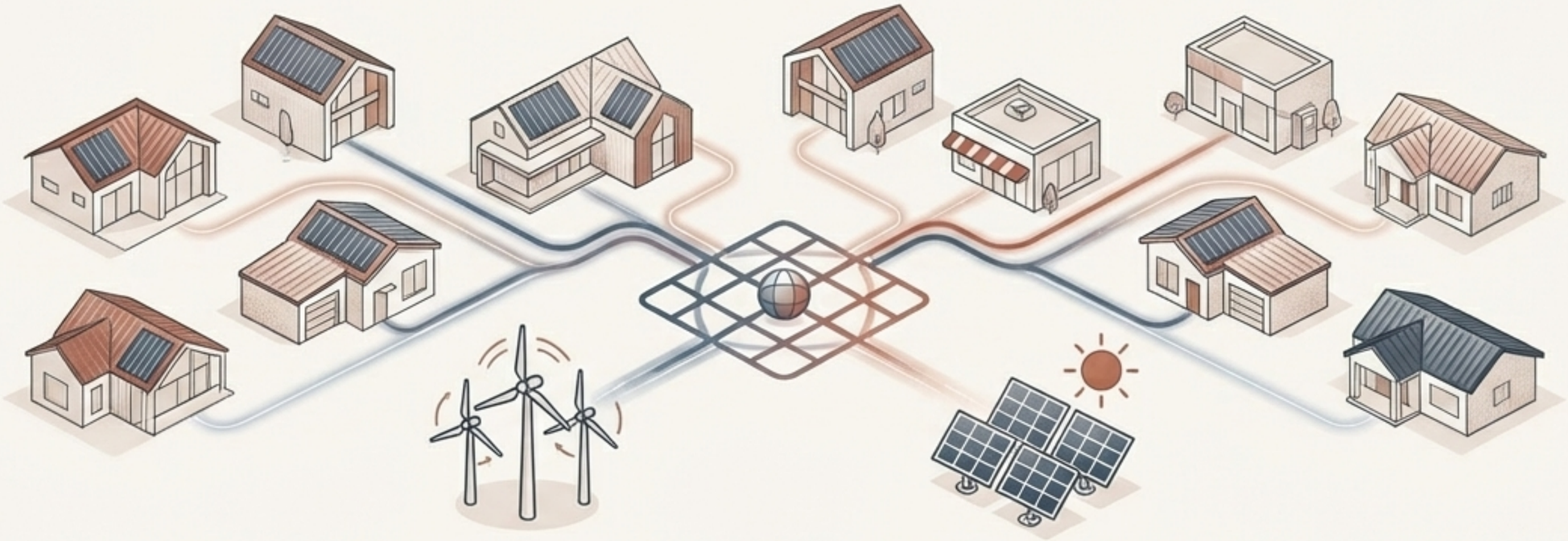
It has been difficult to get people to understand how effective cooling with night sky radiation is. One opportunity is to use the tens of thousands of existing solar swimming pool heaters as radiators to cool buildings at night. A pool heater is not the ideal radiator for a thermosyphon system, but it's a powerful demonstration tool.



"The designer has a running start. He's getting something for nothing, he is harvesting a second crop off his solar pool heater."

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Thermal Storage is a Necessity for the Future Grid.



As the electric grid incorporates more fluctuating renewable sources like wind and solar, the need for energy storage becomes paramount. Thermal storage in buildings is a highly effective, distributed solution. A building with a Di-Thermal system doesn't just **reduce** its own load; it becomes a thermal battery that can help balance the grid.

"A grid fed more and more by wind generators and solar panels create more and more need for storage... Whatever suits natural heating and cooling will also suit the electric grid."

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The Future of Comfort is the Luxury of Silence and the Elegance of Simplicity.
This is more than a technology; it is a different standard of living. It replaces the noise and drafts of mechanical systems with the silent, pleasant, and constant comfort of radiant surfaces that are in tune with the natural world.
“The success of the Di-thermal roof will likely depend on marketing the luxury of radiant heating and cooling as a necessity to save energy.”

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