Who we are:

A DESIGN BUILD COMPANY

+ PRODUCT DISTRIBUTOR, PERFORMANCE TESTER and ENERGY ANALYST
What do we do?

We DESIGN + BUILD Q+ homes that can PRODUCE MORE ENERGY than they consume.

We have committed to build all our NEW PROJECTS so that their building ENVELOPE meets the PASSIVE HOUSE STANDARD.
Larkspur Remodel
Overview:

• The existing house: what it needed
• Our approach to the remodel
• Building materials & details
• Testing & Energy comparisons
• Some preliminary conclusions!
Our Process:

• Review the existing structure: what had to be replaced, what could be saved?

• Analyze the process for energy efficiency, least waste and disruptive install process, lowest toxicity.

• Review the cost/benefit: what should be done now, what could be saved for later?
The existing home:

- Cabin style
- Simple shape
- Needed new roof
- Needed new windows
Positives:

- Existing sealed crawlspace
- Existing ventilation system with HRV
- Existing Solar HW and PV
- Simple shape
Negatives:

- No roof insulation
- Minimal wall insulation
- Un-insulated foundation
- Aluminum frame single-pane windows
Client’s goals:

- Improve indoor comfort
- See what it would take to meet PH standard
- Build for her children’s future
The Passive House approach:

- Super-insulated building envelope with no thermal bridges
- Airtight to 0.6 ACH @ 50pa
- Mechanical Ventilation with > 80% Energy Recovery
- 4.75 kBTU/sf²yr max energy demand, 38 kBTU/sf²y Primary Energy Demand
The Wall & Window system:

BEFORE:

- Redwood faced plywood siding
- 2x4 stud walls
- Fiberglass batt insulation (poorly installed)
- Wood panel interior on furring strips

R-Value: 11.1 (hr*ft²°F/ BTU)
The Wall & Window system:

AFTER:

- Rainscreen siding w/ Hardi siding
- Building paper
- 3” Mineral wool insulation
- Airtight barrier: (Redwood faced plywood siding)
- Existing wall remains

R-Value: **22.3** (hr*ft²*F/BTU)
Window details:

R-Value: 8 \((\text{hr}.\text{ft}^2.\text{F}/\text{BTU})\)
R-Value: 1 \((\text{hr}.\text{ft}^2.\text{F}/\text{BTU})\)
Exterior Insulation:
Roof system:

BEFORE:

- Asphalt shingle roofing
- T & G sheathing exposed to the interior
- 6x8 rafters @ 4’-0” oc.
- No insulation

R-Value: 2.2 (hr·ft²·F/BTU)
Roof system:

AFTER:

- 6” metal-clad foam prefab panel roofing
- Same roof system with wall insulation wrapping up to the roof insulation.

R-Value: **50.2** (hr*ft²/F/BTU)
Roof installation:
Foundation & Perimeter:

BEFORE:

- 4" Concrete slab
- Conventional spread footing
- No insulation

R-Value: 1.4 (hr*ft^2*F/BTU)
Foundation & Perimeter:

Note: We didn’t install the above-slab insulation at this time. Cost and complexity were the limiting factors. However, we do see this as possible for a future renovation and know that the rest of the structure will allow final PH Certification at that time.

AFTER:

• 3” interior foam/mineral wool insulation ‘installed’ above the interior slab
• 2” foam insulation at the perimeter

R-Value: 10.2 (hr*ft²°F/ BTU)
Foundation details:
Foundation details:
AIRTIGHTNESS!
Testing, testing…

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<tr>
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<td>Equiv. Hole (sq inches)</td>
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<tr>
<td>PHPP (ach/hr n50)</td>
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Source: Sustainable Spaces GreenUP report for client, 2007, & PHPP
Previous energy cost:

EXISTING
(kWh/sf, yr)
Elec: 4.46
Gas: 8.08
Total: 12.54

Total Yearly Energy Cost: $2,678

Source: Sustainable Spaces GreenUP report for client, 2007
Where the losses were:

- Walls: 29%
- Windows: 25%
- Air Leakage: 10%
- Duct Insulation: 4%
- Duct Leakage: 6%
- Floors: 6%
- Attic: 20%

Source: Sustainable Spaces GreenUP report for client, 2007
Projected energy use:

Note: The projected energy use assumes final PH compliance. It has been modified for variance between PHPP TFA and typical overall sf energy use calculations. Benefit of the Solar PV system is not included. However, since we did not install the slab insulation, it will likely be higher.

Source: Sustainable Spaces GreenUP report for client, 2007
Compared to others:

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Source: PG&E & Sustainable Spaces GreenUP report for client, 2007, & PHPP
Projected leaks:

- Windows: 29%
- Exterior TB: 23%
- Perimeter TB: 7%
- Walls: 16%
- Roof: 15%
- Slab: 5%
- Basement floor: 5%
- Wall - Ground: 0%

Source: PHPP file for this project
Bug screens...
Exterior shade screen…
Early conclusions:

• The PH air-tightness can be achieved on retrofits with careful planning and testing

• The economic case is challenging for this particular project (but makes solid sense for new construction.) Cost: $85/sf.

• The improvement in occupant comfort is already being enjoyed by our client

• Energy analysis… Watch this space!
Thank you from the Team:

**Architect:**
Josh Moore

**Project Manager:**
Carlos Velasquez

**Crew:**
Attu Fave
Paea Favaleaki
Peter Soruco

**Testing:**
Stefan Carpentier

**Energy Analysis:**
Mary Graham
Bronwyn Barry