



Katy Hollbacher, P.E. | beyondefficiency.us

Carmel-by-the-Sea Passive House: Fine Homebuilding's Best New Home



Presented For:

8th Annual North American Passive House Conference, Pittsburgh, PA | 18 October 2013

Before...



After: Fine Homebuilding Best New Home!



BEST NEW HOME
Our award for Best New Home goes to architect Linda Parry and builder Paul Hasty for the certified Passive House they built on the Monterey Peninsula in California. With its exceptional performance and equally beautiful style, this house stands out as one of the best before us for this home building.

Passive House Perfection

This compact farmhouse achieves home building's highest performance standard without a shred of aesthetic compromise

BY JUSTIN PALAY

As the fog grows up in California, Mia and Lauren look together to make other plans throughout their busy season. Their beautiful home stands firm on the West Coast, though, and they signed to smart use the. They eventually found a small piece of property in the coastal village of Carmel by the Sea on the Monterey Peninsula, and they bought an address without a look at Carmel Building & Design as builder for a new house that will one day be their permanent home. The collaboration yielded a new type of house for the area, one that appropriately blends the style of local architecture while embracing the country's most aggressive performance standards.

The Passive House is a first for Carmel, for Mia, and for the city of Carmel. Working on this project has confirmed for Mia and Lauren the importance of sustainable, high-performance design and building. For the site and for those who now get to experience the home, Carmel Building & Design makes a real-time plan design and performance can be better than ever, very high standards for beautiful, exceptionally low-energy homes are within our collective reach.

A Year of Passive House

One of the initial challenges with our project was providing Mia and Lauren with the house that they wanted while also embracing Carmel's strict planning commission that the project would compromise the existing city fabric. When we first saw the project with our mission, we were very excited about the idea of building Carmel's first Passive House that we included the Passive House Institute. Unfortunately, due to some last-minute approvals of what we hoped, instead of getting people excited about our project, it turned them into skeptics that we were going to build a box with a wall of south-facing glass and few other openings. While the



Carmel
dining area with its dramatic vaulted ceiling and passive radiated heat. The dining area includes the kitchen, a large bay window. Even the glass will light from the north, while the rest of the house is the opposite and pass to the north.

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Evoking comfort in an open plan

The floor plan has carefully designed spaces for gathering and retreat. The size of the plan is the scaled living room, which brings people together in the heart of the home. More intimate spaces branch off this central space, and are enriched with elements that make them inviting and comfortable.

Living room

The living room has a fireplace with a stone surround and a large window with a view of the outdoors. The space is designed to be a central gathering place for the family, with a fireplace and a large window. The living room is a great place to relax and enjoy the view of the outdoors.



Light green cabinets topped with natural stone. Includes quartzite, oak, marble, oak, a touch of a white tile backsplash to create a bright, clean, classic space for cooking and entertaining.



Wood is the main material used in this bathroom. The bright, oak wall adds to the living room's natural, elegant, farmhouse aesthetic.



In the adult bedroom, a sliding barn door with an openable window helps to bring the room's farmhouse style and natural greenery of the top of the view.

SPECS	
Bedrooms: 2	Completed: 2017
Bathrooms: 2	Location: Carmel, Calif.
Size: 1,600 sq. ft.	Architect: Peter Dreyer Architecture
Cost: \$425 per sq. ft.	Builder: The House, carmelbuilding.com

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Components for conservation

design might be one of some Passive House, one plan called for a different home. Mike and Lauren wanted a contemporary farmhouse with a clean, crisp, and inviting exterior, and an interior with an open floor plan that would use a series of outdoor spaces to create a strong relationship with the small lot dimensions etc. Fortunately, the contractor was able to see the vision, and one plan was approved.

Working around the redwoods

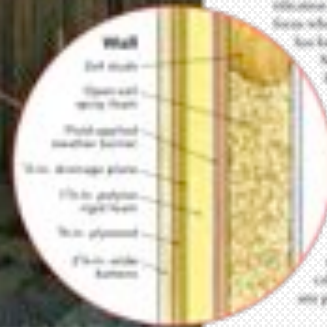
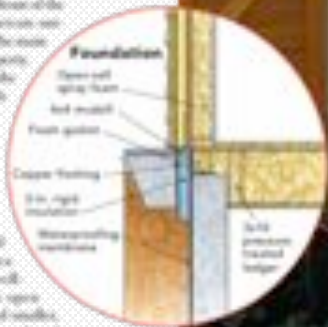
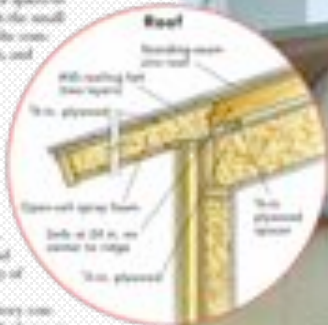
The lot is a 6000-sq-ft, flag-shaped parcel located in redwood woods. By retaining houses and on the north side by a cluster of massive redwood trees. These redwoods are the dominant feature on the property and became the inspiration for many of the home's design decisions.

The lot's physical and regulatory constraints led us to position most of the house at the rear of the property, with a small single-car garage placed at the front. The garage is linked to the house via a concrete, covered breezeway that steps down slightly to accommodate a subtle change in topography across the site. We placed a small courtyard directly behind the redwood trees and in front of the main living space, and a more private outdoor area directly to the south of the main living space at the rear of the property.

The garage and breezeway give the property a "compact" feel, while the outdoor areas tie the interior spaces to the exterior site and help to give the compact home a needed sense of openness.

Open spaces and intimate places

In addition to well-connected indoor and outdoor spaces, Mike and Lauren also requested a well-designed kitchen with a large open space suitable for entertaining and smaller, more intimate spaces for relaxing and reading. The compact kitchen and nook lead to the north of the dining room to the south are a small dining room, a breakfast room, a master bedroom, and stairs to the second-floor suite. With the vaulted dining area, well-lit openings to the north and south, both the house a sense of grandeur, all of the other rooms have a more intimate feel



This house revealed all the new ways to provide sustainable energy that we have for us today. The house is a well-designed structure, all of the new passive energy and design features are in place. The house is a well-designed structure, all of the new passive energy and design features are in place. The house is a well-designed structure, all of the new passive energy and design features are in place.

because of their smaller footprint and warm, natural finishes.

A twist on a traditional style

Many of the interior and exterior spaces include traditional elements considered as more modest detail. Inside, a palette of exposed white-washed rough-sawn Douglas fir framing, integral colored glazes, and floor-to-ceiling walls of reclaimed brick wood adds to the warmth of the space. Board-and-batten detailing on the upper portion of the fireplace and a large sliding barn door in the opposite bedroom continue to reinforce the farmhouse aesthetic.

We covered the exterior in white board-and-batten siding that ties into a continuous water table, with lap siding below to offer a sense of grounding to the home's lines.

We chose standing-seam zinc-coated steel for the roof, with zinc coils used for the fascia and soffits of the eaves. This board-in-eave detail gives the whole lot the clean feel of a European chalet that has been dropped neatly onto the home below. Additionally, the large cedar sliding barn door and the reimagined scale of the fireplace window at the stairwell to the north-deck area are prominent elements that push the home's style toward the contemporary.

Stacking energy use

The Passive House approach to building hinges on maximizing the amount of energy contained in a home by providing extremely high levels of insulation and minimizing air leakage. Unlike other rating systems and certification programs, Passive House seeks to focus wholly on energy consumption, which has long been a concern for Rob and me.

Several design strategies helped the house to achieve its performance goals. The compact footprint is a key attribute of a super-low-energy building. Furthermore, we maximized the amount of solar gain to the main living areas of the house through generous amounts of southern glazing. Passive Houses tend to minimize the amount of glazing on their north sides, which typically shed energy without providing any positive solar gain to the rest of the

house, however, eliminating windows and doors on the north side would have changed the entire look and feel of the house.

Fortunately, we were able to compensate for the large glazed openings to the north by using more insulation in the walls and roof. A combination of advanced framing techniques and what we consider a "dead-skinned" construction approach to the roof and walls gave us a well-insulated envelope and enabled us to hit our Passive House targets. If the house performs as modeled, it will use approximately 10% to 20% of the energy consumed by a code-built house.

Our mechanical system is composed of a Radiant heat recovery ventilator (HRV) that serves two purposes. First, it provides a continuous flow of fresh air into the house. Second, it uses waste indoor air to preheat fresh makeup air through a heat exchanger core to minimize overall heat losses. A hydronic coil added to the HRV serves as a backup heating element. With the extra use of radiant heat, the entire mechanical system serves as a fairly conventional over-engineer under the house. This design detail means that we had to bring a concrete slab, which is also used as Passive House's main solar energy. As an alternative, we incorporated phase change materials (PCM) into the wall assembly on the north side of the house to serve as a thermal heat sink. PCMs help to regulate indoor temperatures by absorbing excess heat during the day and slowly releasing the heat in the evenings, which the interior temperature dips below the 73°F set point. PCMs simply install as sheetrock behind the drywall of the interior walls.

Other than the use of PCM, the construction of this house was intentionally straightforward. I hope that many of the design and construction techniques we used will become mainstream as the years ahead and that high-performance houses such as this will become synonymous with high-cost construction. ☐

Justin Pharis is an architect in Monterey, Calif. Photos by Rob Vogel, except where noted.



Orange author: New home or not? www.finehomebuilding.com for an inside look at this home and these behind-the-scenes.

Fine Homebuilding Best New Home!

The Builder's Journey



How I came to build FHB's best new home of the year, and what it taught me

BY BOB HIGLEY

Designer/owner/organizational strategy from the inside, I have spent the past 20 years in construction thinking about how to do it right: the analytical and organizational aspects of my job as well as the business of it. Because I see the craft of building, I am always looking for ways to learn more. This does not mean I have looked out over the world of green building. After years of attending training programs and conferences, reading books and magazines, and studying in schools, seminars and classes, I have had a lot of education. Advanced Home Programs is proud to feature this feature for you.

Along the way, however, something went wrong. I realized that I wasn't practicing on what was happening around me or in my other aspects. I was thinking about where my building materials came from and where the waste from my projects would go. I wondered if my practices were getting the visibility of the concerns I was seeing. It felt like I was missing an opportunity to address sustainability. These questions started to color the way I looked at what I was doing as my work.

I discovered Passive House when I saw a magazine. It was a way of building that reduces energy demand by eliminating heating and cooling the building shell. I was looking forward to building a Passive House, and I finally got the opportunity with what became FHB's 2015 Best New Home ("Passive House Perfected," pp. 48-50).

Standard change permanently

When I started getting into green building, I had lots of normal building practices as a baseline. As soon as I started, I have thought about making changes. I did. At my firm, we identified low-risk/high-impact changes versus high-risk/low-impact ones. In the beginning, we did small things, like making sure to use low-VOC paints so that it could be recycled and choosing low-VOC products. We started making a hard hat as well as your go-to when you're on a construction site. The goal, as an owner-builder, is to do what you can to improve the way you do things. It's not about making changes that will cost too much or that will take too long to implement. The goal is to do what you can to improve the way you do things. It's not about making changes that will cost too much or that will take too long to implement. The goal is to do what you can to improve the way you do things.

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Bob Higley is a builder in Carmel, Calif. His website is bobhigley.com.



"Advanced framing is easy"

Using advanced framing—also known as double studs—cut or girding studs as 2x6 to create extra space, loading rafters directly over studs, avoiding complex connections where possible, using leaders to connect beams and adding lighter corner and partition walls—these are the things that have led to the success of our Passive House. These things would be in a conventional framed house. The goal is to have the framed look that is so anticipated. When some of the materials are employed in such a way, the energy use is not too high. This is a house that framed look that is so anticipated. When some of the materials are employed in such a way, the energy use is not too high. This is a house that framed look that is so anticipated.

"Additional standards are within reach"

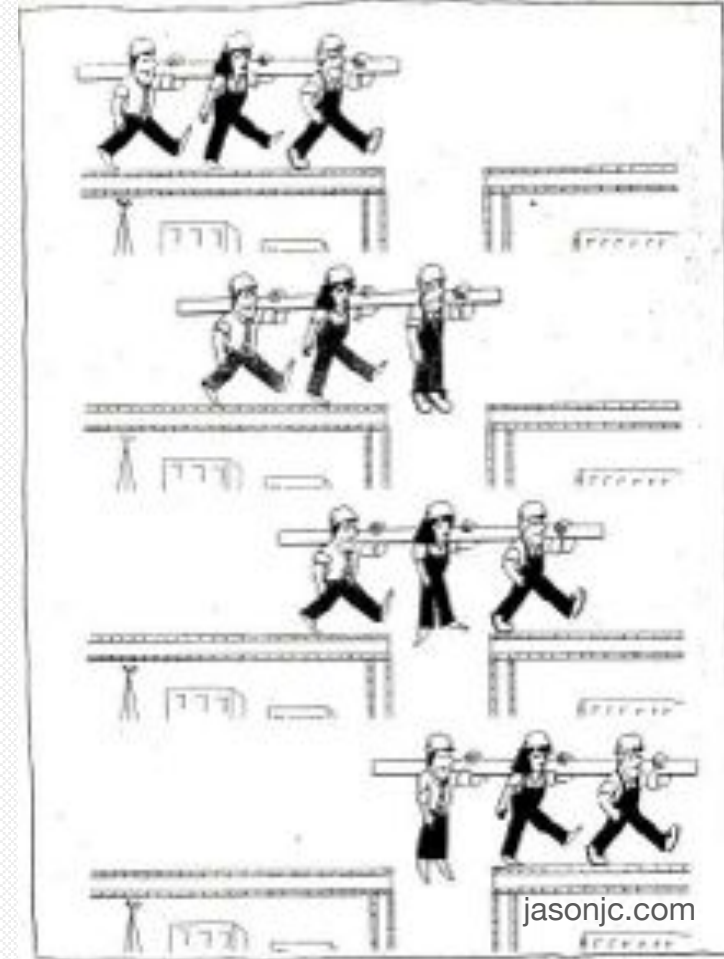
In this project, we worked to look for meeting Passive House standards and doing a few other things that we had already made changes to. We are already in the use of low-VOC paint and adhesives. We were already in 2007 for Passive House. We decided to look for other measures to address LEED. Passive House, we got a California Advanced Home Program (CAHP) rebate. It's a big deal. We got a rebate. It's a big deal. We got a rebate. It's a big deal. We got a rebate. It's a big deal.


"It takes a village"

Remember the good old days when if you had a idea, a plan, a dog, and a tool belt, you were in business? Now there are the additional aspects of what a project that requires a Passive House level of performance requires that you work with a team of people who are willing and able to collaborate to create the desired outcomes. The architect, owner, energy modeler, structural engineer, builder, interior designer, and other roles such as the interior and exterior people of need to be aware of the objectives and how to work with it. Contributing solutions to the inherent challenges of building a high-performance home. To me, this is a major milestone in the industry's becoming more rigorous and technical. We are going from building the old-fashioned way to the new. We are going from building the old-fashioned way to the new. We are going from building the old-fashioned way to the new.

Carmel Passive House Team

- Architect: Justin Pauly Architects
- Structural engineer: Derek Bonsper, Duckbrew
- Builder: Carmel Building & Design
- CPHC & LEED Homes Rater: Katy Hollbacher, Beyond Efficiency
- HERS Rater: Steven Jungerberg, RetroGreen Homes



A photograph of a modern, rustic interior. In the foreground, a stone fireplace with a wooden mantel is lit. To the left, a large painting of a rooster is mounted on a white cabinet. In the background, a dining table and chairs are visible, along with a kitchen area. The floor is made of light-colored wood. A semi-transparent text box is overlaid on the right side of the image.

“We feel a responsibility as stewards of this Earth and we wanted to build a home that was respectful of the environment and its precious resources. We also learned that good design and modern aesthetics were compatible with the kind of energy efficiency we were seeking and we couldn't be more pleased.”

- Homeowners Mica & Lauren Hill

300 B.C., Rome:

- The three elements of architecture are “commodity, firmness and delight” – *Vitruvius*
- Buildings are for people, and they must be loved to endure.
 - Useful & comfortable
 - Strong, durable & efficient
 - Inspire delight...



Carmel-by-the-Sea

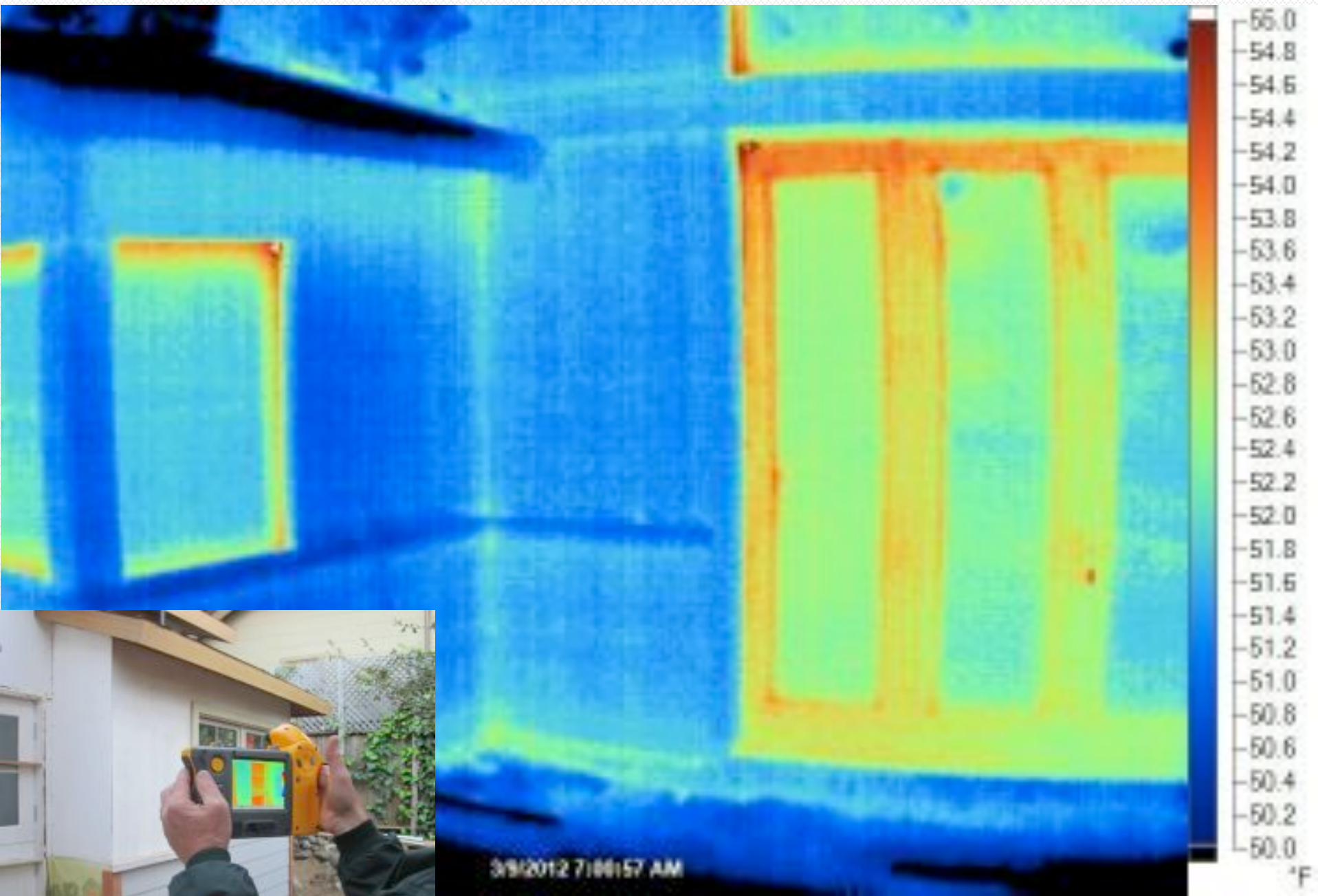


Carmel-by-the-Sea

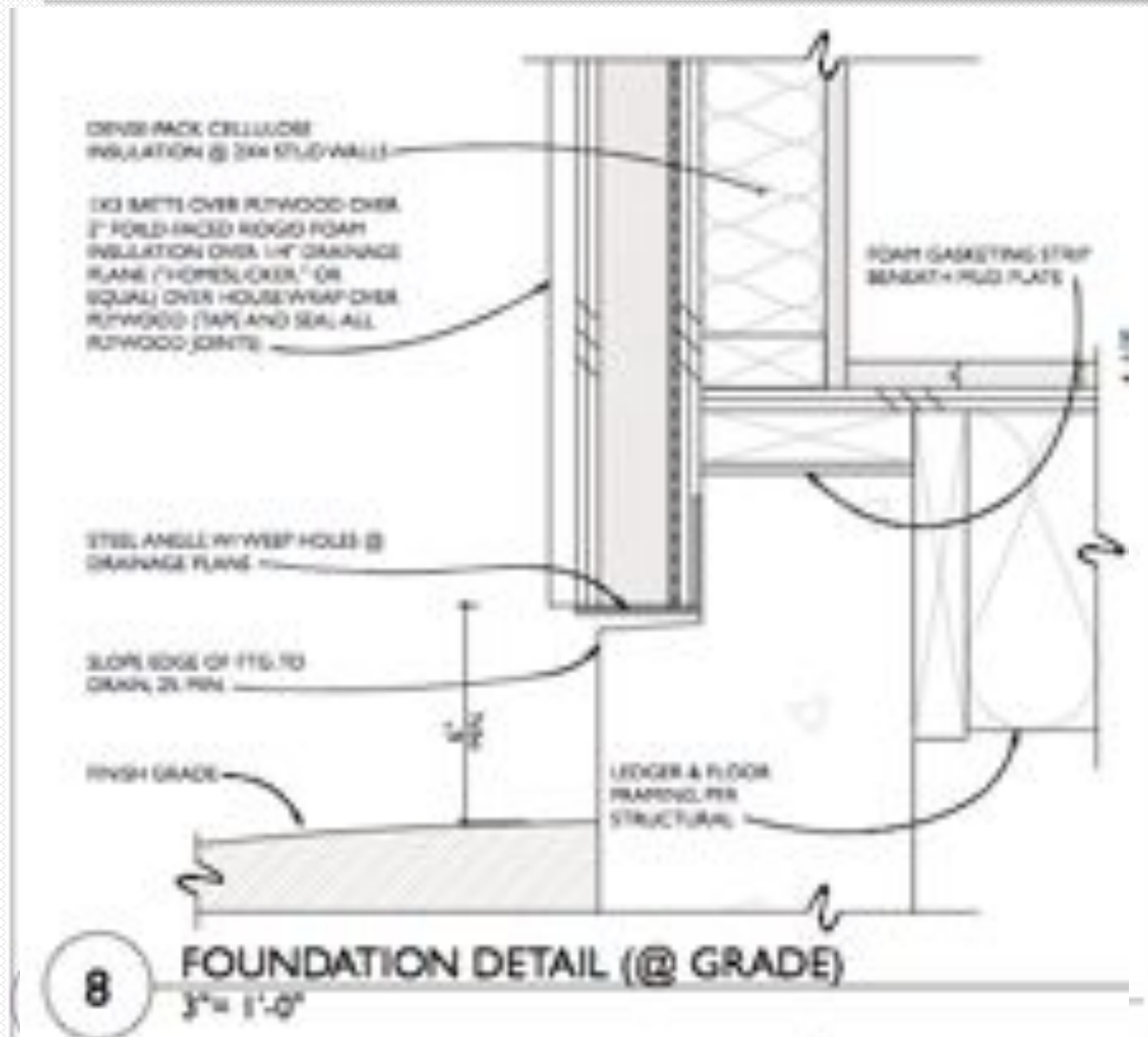




Passive solar windows?
*Nah- this is the north side. We can get
away with a lot in coastal California!*



Raised floor-stem wall connection



Insulation planning





*“Air sealing is
hard”
- builder Rob Nicely*

*Window
aligned within
stud bay*

*Headers
right-sized*

*“Advanced
Framing is easy”
- builder Rob Nicely*

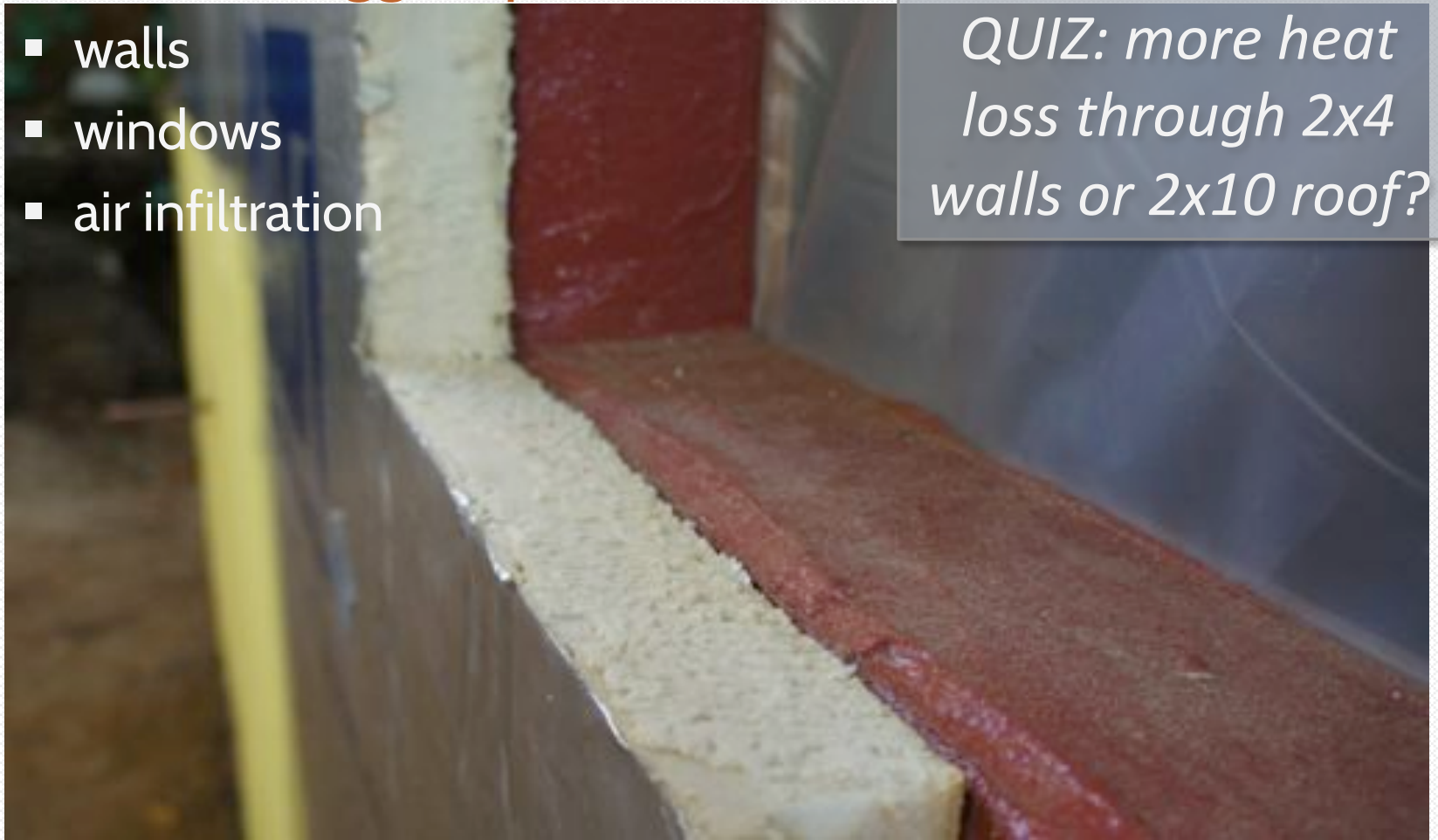
*No unneeded
cripple studs*

Step 1. Minimize heat losses

- Understand your “heat loss pie”, and then...
- Go for the biggest pieces!

- walls
- windows
- air infiltration

QUIZ: more heat loss through 2x4 walls or 2x10 roof?



Conduction → Compactness

- Make building shape more “compact” to minimize amount of exterior wall for every square foot of living space provided

- → save materials
- → minimize construction costs
- → minimize heat losses

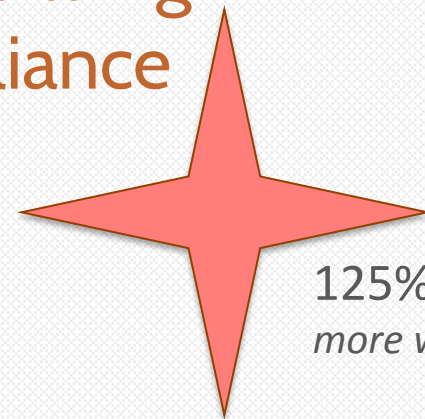
- Typical energy code: shape of building *irrelevant* for determining compliance



13%
more wall



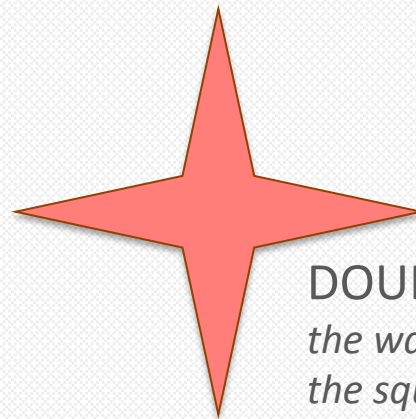
41%
more wall



125%
more wall

Title 24 Code Min for Carmel PH:

- Walls R-13... no matter how much wall!
 - Roof R-30... no matter how much roof!
 - Raised floor R-19* ... no matter how much floor!
- * or R-0 if this were slab on grade!



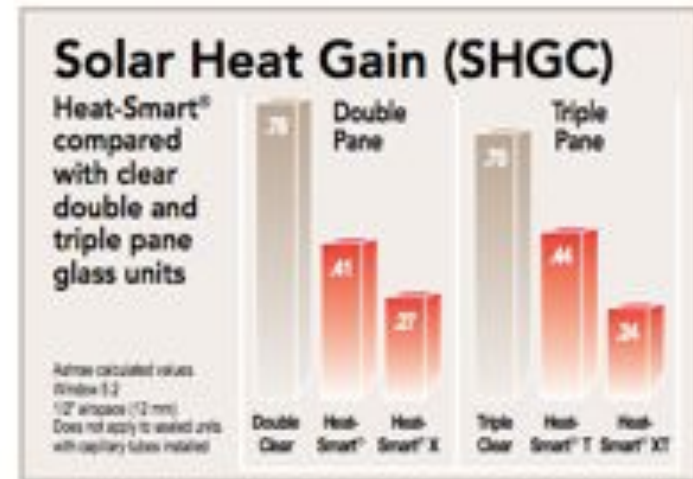
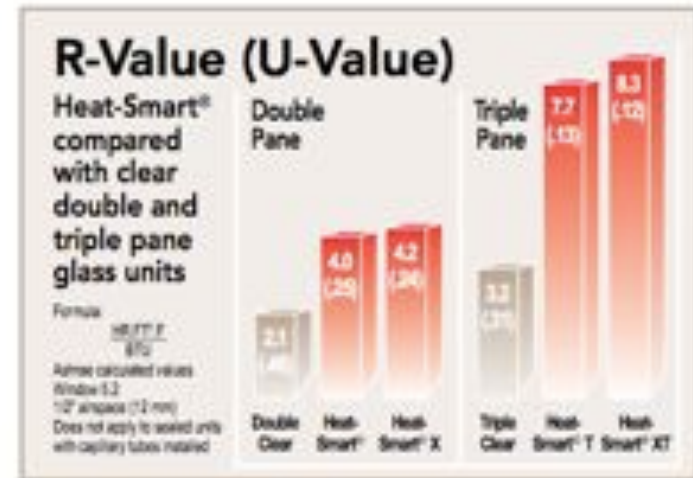
DOUBLE
*the wall area of
the square! but
extra insulation
not required!*

Non-compact: Carmel PH.



Window Choices:

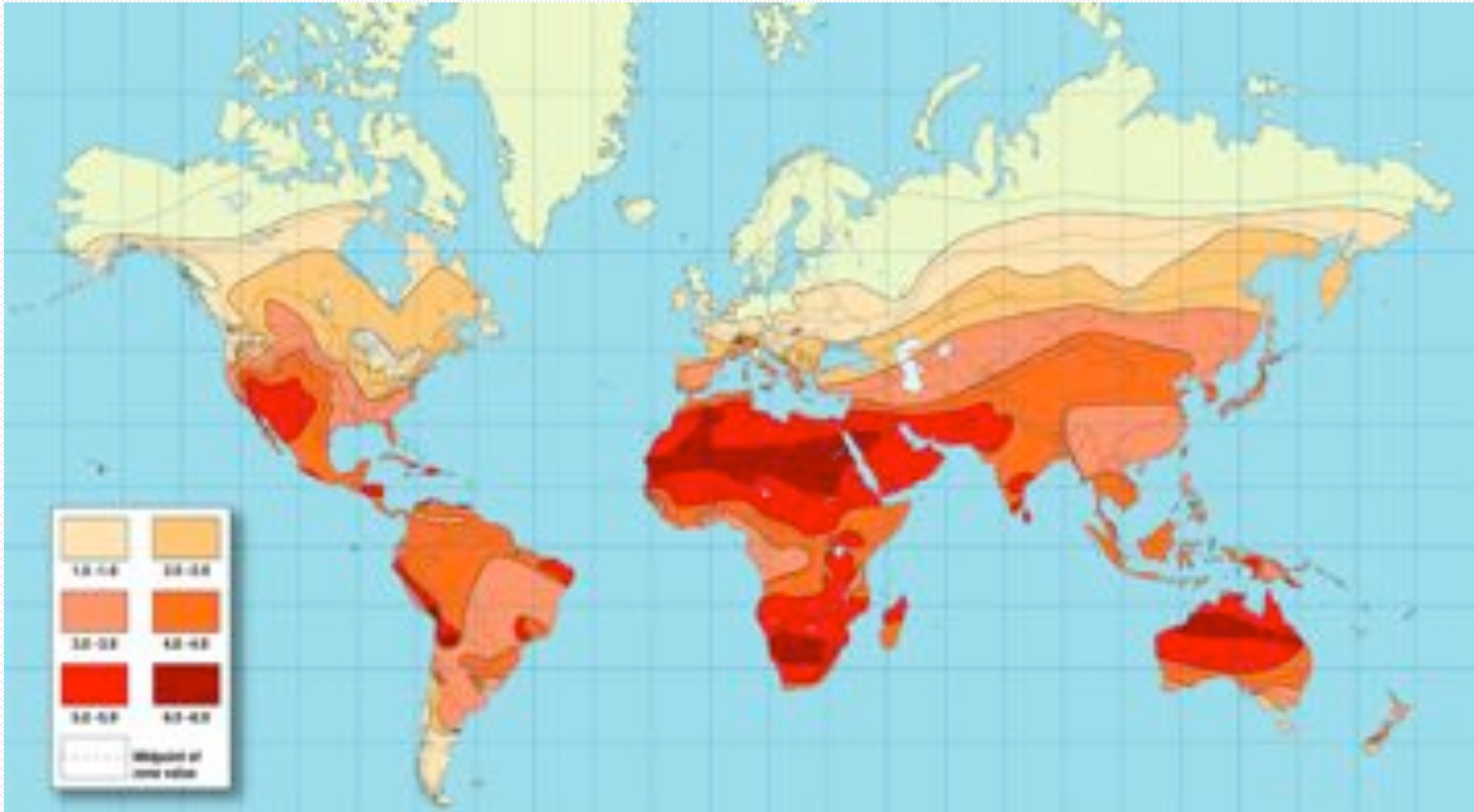
Low U-value not always best.



Loewen Windows

Gas fill vs. Mountains

Solar Insolation Worldwide



Hours of sun per day on an optimally tilted surface during the worst month of the year - NREL

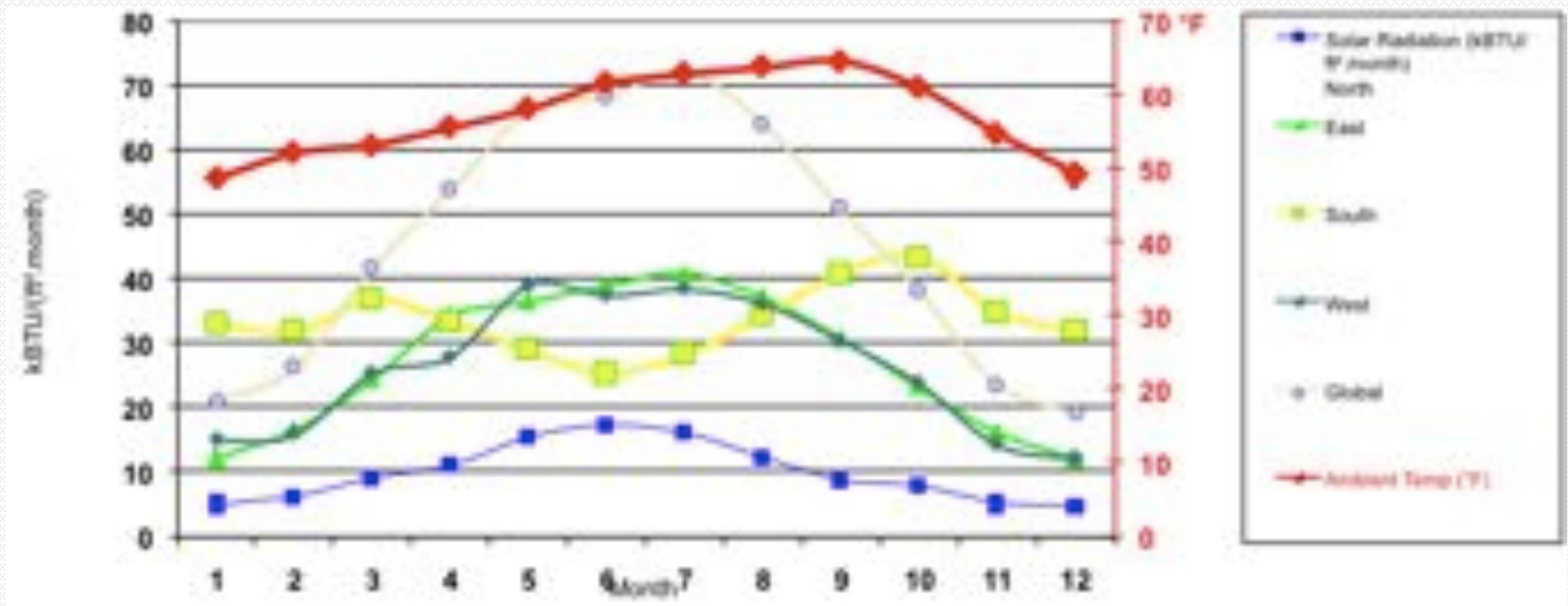
Solar Insolation U.S.



Hours of sun per day on an optimally tilted surface during the worst month of the year - NREL


Solar Radiation Data

- Insolation =
INcoming SOLar radiATION
- Measurements, kBtu/ft²:
 - Horizontal (flat)
 - Vertical (N,S,E,W elev.)



San Francisco climate data from PHPP

Passive Solar Is Not Dead...

The image shows the interior of a wooden building under construction. The ceiling and walls are made of exposed wooden beams and studs. A large window in the center provides a view of a bright blue sky with light clouds. Two warm-toned string lights are strung across the ceiling, one on the left and one on the right. A semi-transparent text box is overlaid on the window.

*Especially in
California & other
sunny climates!*

South side



Old Thermal Mass Is Dead...



KNAACK

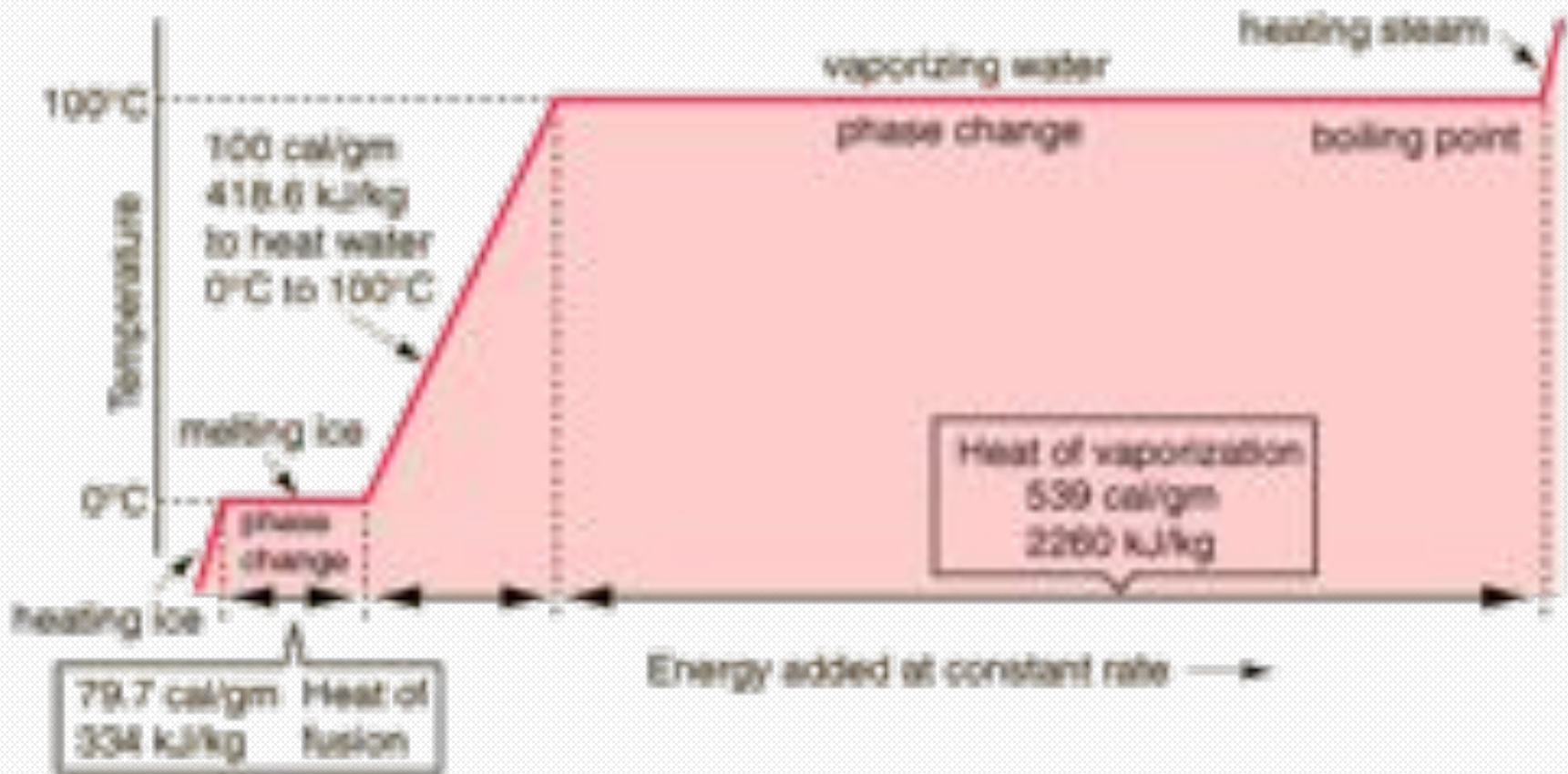
*For those who
don't want
concrete floors.*

Thermal mass 2.0:

- Phase change materials (PCMs)
- Specify product's temperature setpoint to act as “thermostat” at that temp
- Carmel Passive House product: BioPCmat
 - One square foot equals heat storage capacity of 1 cu.ft of concrete (27 BTUs)
- PCMs = “Smart” thermal mass!



PCP (Phase Change Physics ;)



Window Design Challenge

	Transmission Losses	Heat Gains Solar Radiation	
	kBTU/yr	kBTU/yr	Ratio Gains:Losses
North	1904	877	0.46
East	2403	3411	1.42
South	2754	6349	2.31
West	1732	1484	0.86
Horiz.	0	0	
TOTAL	8794	12122	1.38

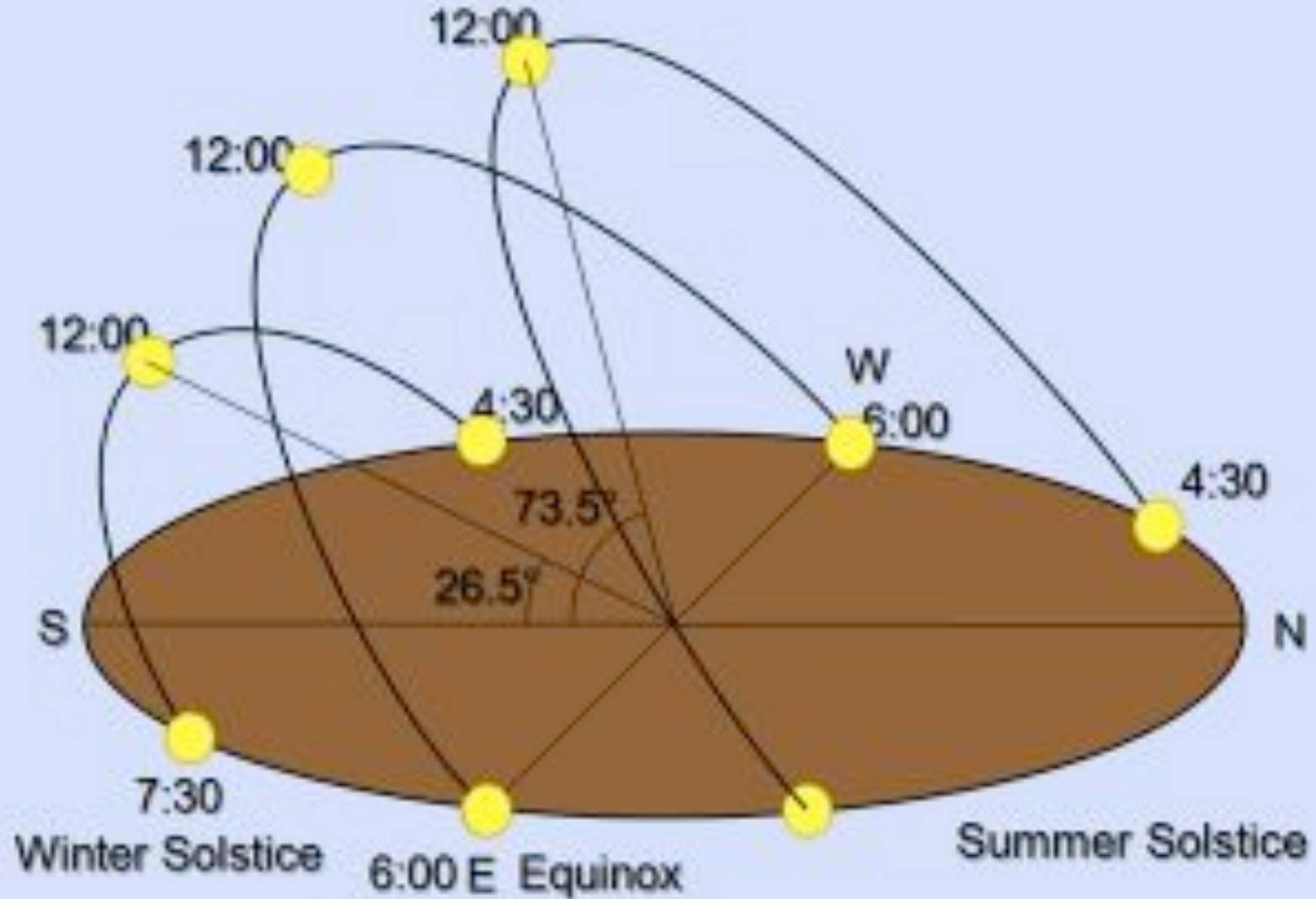
*PHPP
"Window" tab*

Maximize gain:loss ratios

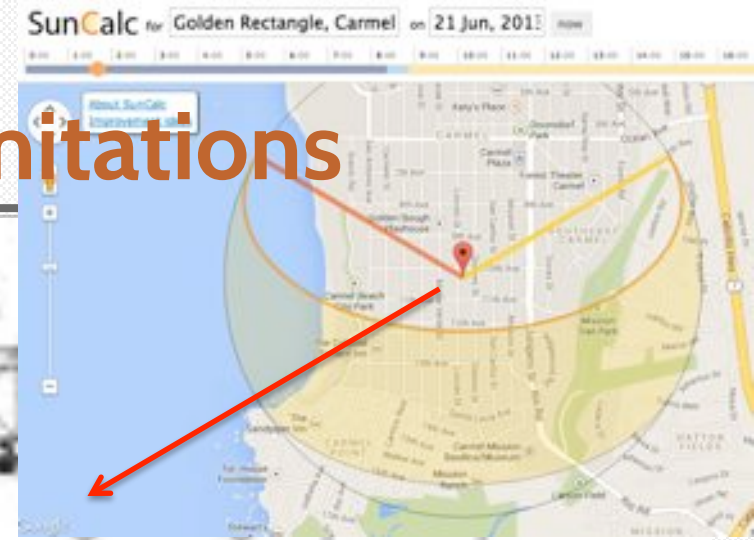
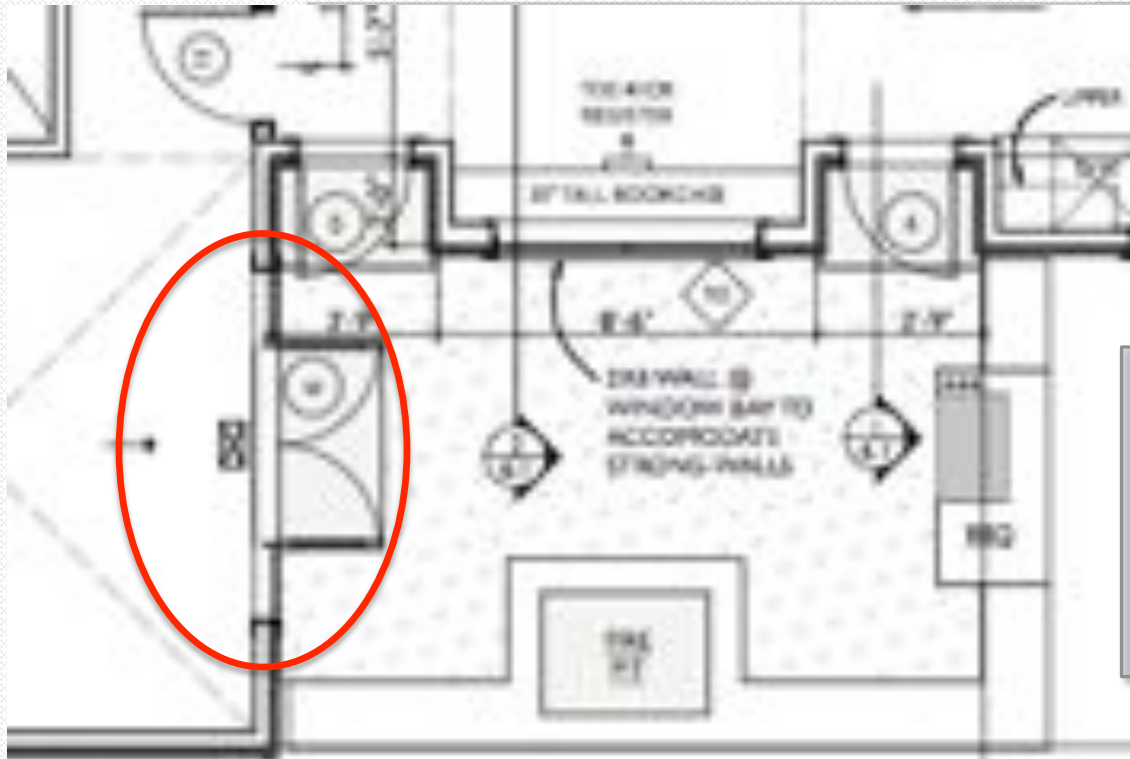
Sunpaths

40°N Latitude

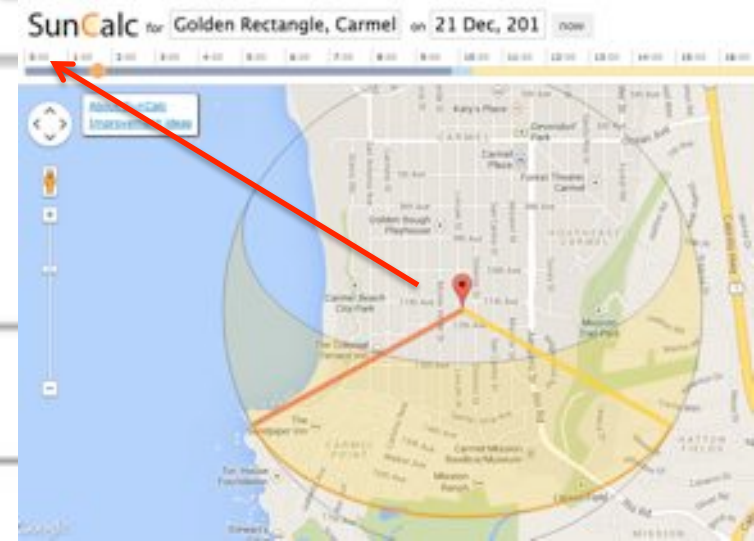
<http://facweb.bhc.edu>



PHPP's Shading Limitations



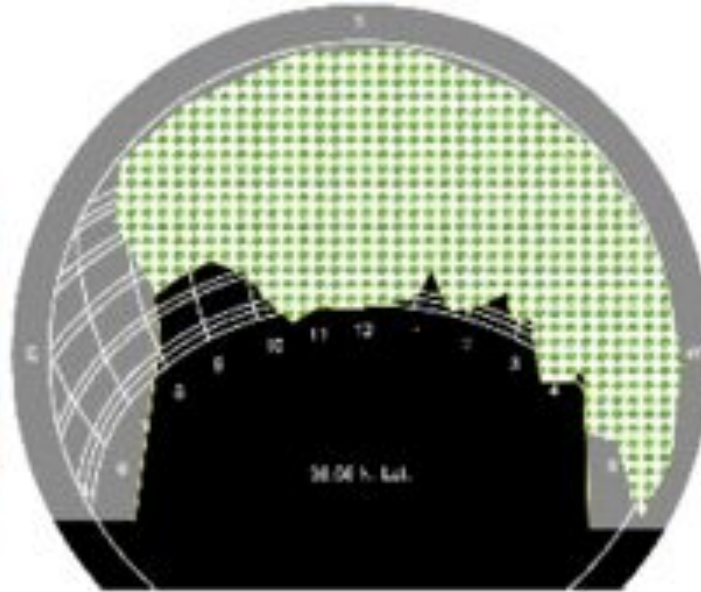
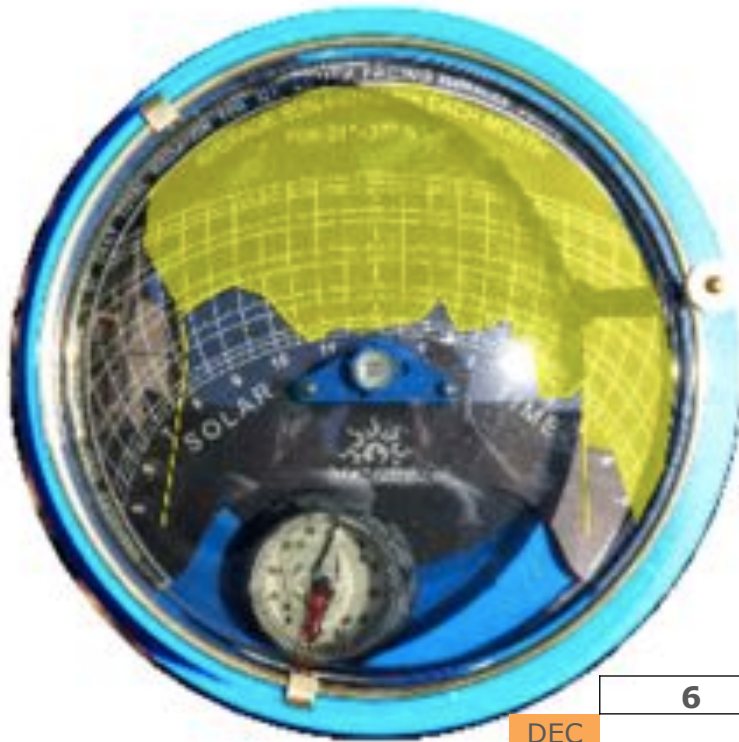
*Morning shade
in summer...
But no shade in
winter*



*PHPP can't differentiate left vs.
right returns
PHIUS approach: average them*

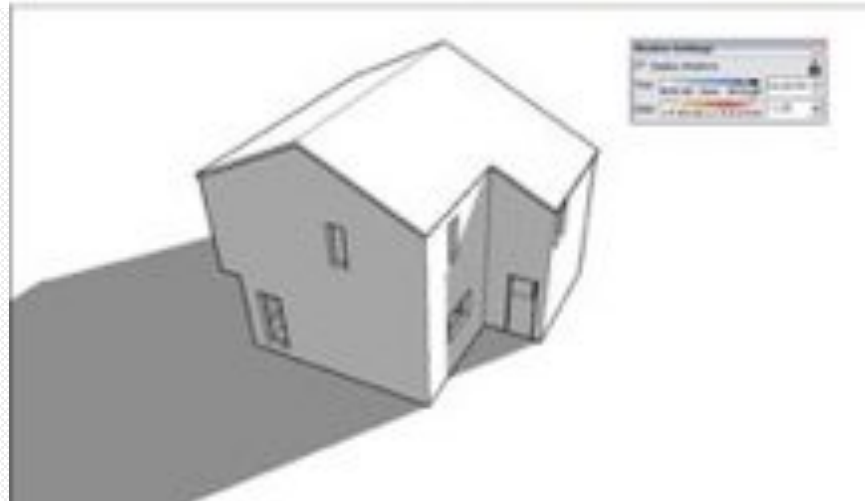
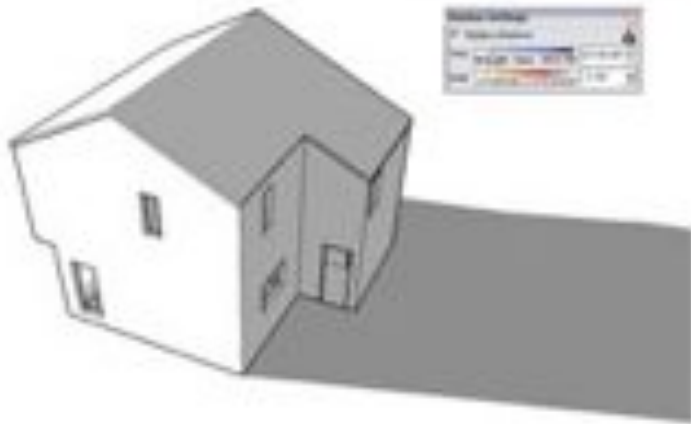
Shading Studies w/ Solar Pathfinder

Notes: South facade, 2/2

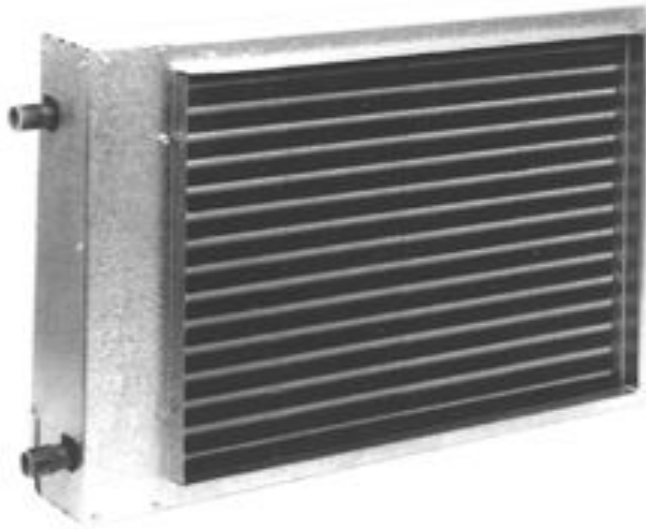


	6	7	8	9	10	11	12						
DEC			0	0	2.4	3	3.6	5.6	4.2	8	6.4	6.4	
JAN			0	0	1.8	2.4	3	3.6	5.6	4.2	4.2	4.8	6.4
NOV			0	0	1.8	2.4	4	3.6	4.2	5.6	5.6	4.8	4.8
FEB		0	0	0	2.4	2.4	3	3.6	4.2	4.2	5.6	4.2	4.2
OCT		0	0	1	1.5	0	0	0	0	0	0	3.5	3.5
MAR		0	0	0	1.8	3.2	4	3.6	4.8	5.6	4.2	5.6	5.6
SEP		0	0	0	1.5	2	2.5	3	3	3.5	3.5	3.5	3.5
APR		0	0	0	1.5	4	5	6	4.8	5.6	4.2	4.2	4.2
AUG		0	0	0	1.5	4	5	6	3	3.5	0	0	0
MAY		0	0	0	3	4	5	5	3	3.5	3.5	3.5	3.5
JUL		0	0	0	3	4	5	5	6	3.5	3.5	3.5	7
JUN	0	0	0	0	3	4	5	5	6	3	7	7	7

Shading Studies w/ Sketchup



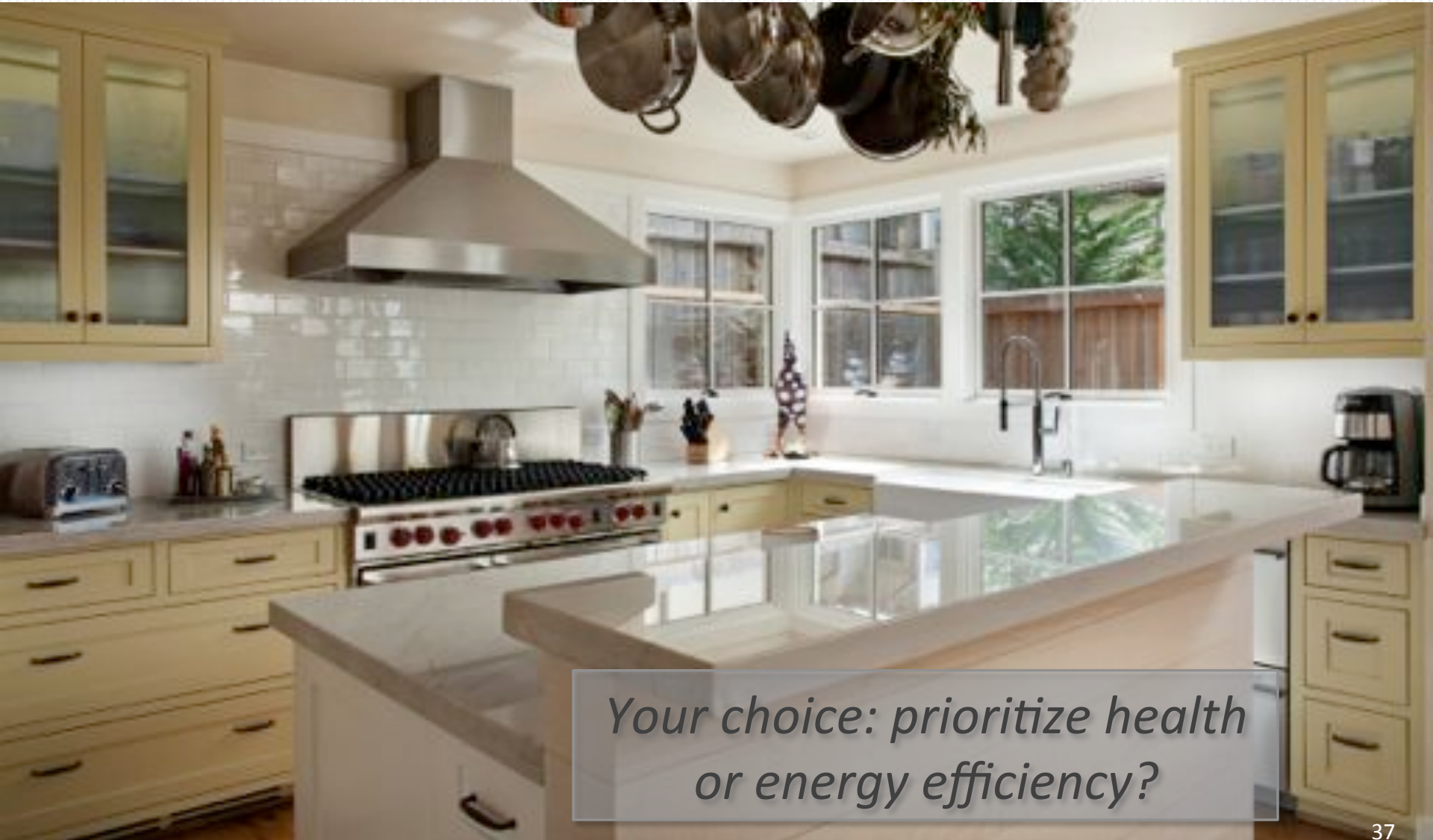
Iconic PH: Post Heat Ventilation Air



HWC1520		PERFORMANCE DATA		
GPM	PRESSURE DROP (FT. WTR.)	HEATING BTUH (10		
		120°F		
		800 CFM	1000 CFM	1200 CFM
3	1.2	24.2	27.4	30.1
5	3.4	26.4	30.4	33.8
7	6.7	27.6	31.9	35.7
9	11.0	28.2	32.7	36.8

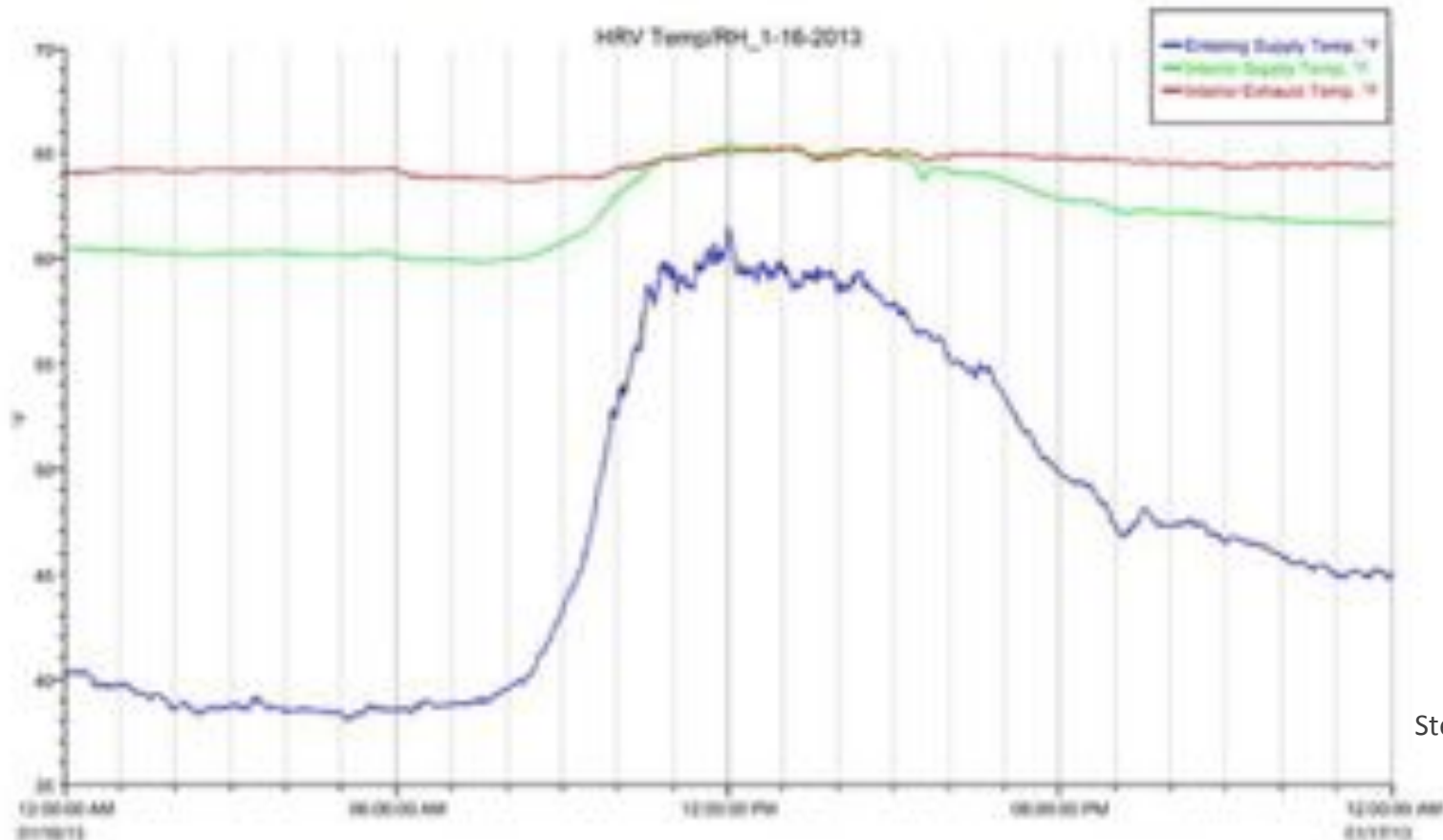
First Co. HWC series duct coil paired with Zehnder ComfoAir 350 HRV

Kitchen range hood



Monitoring: HRV port temps

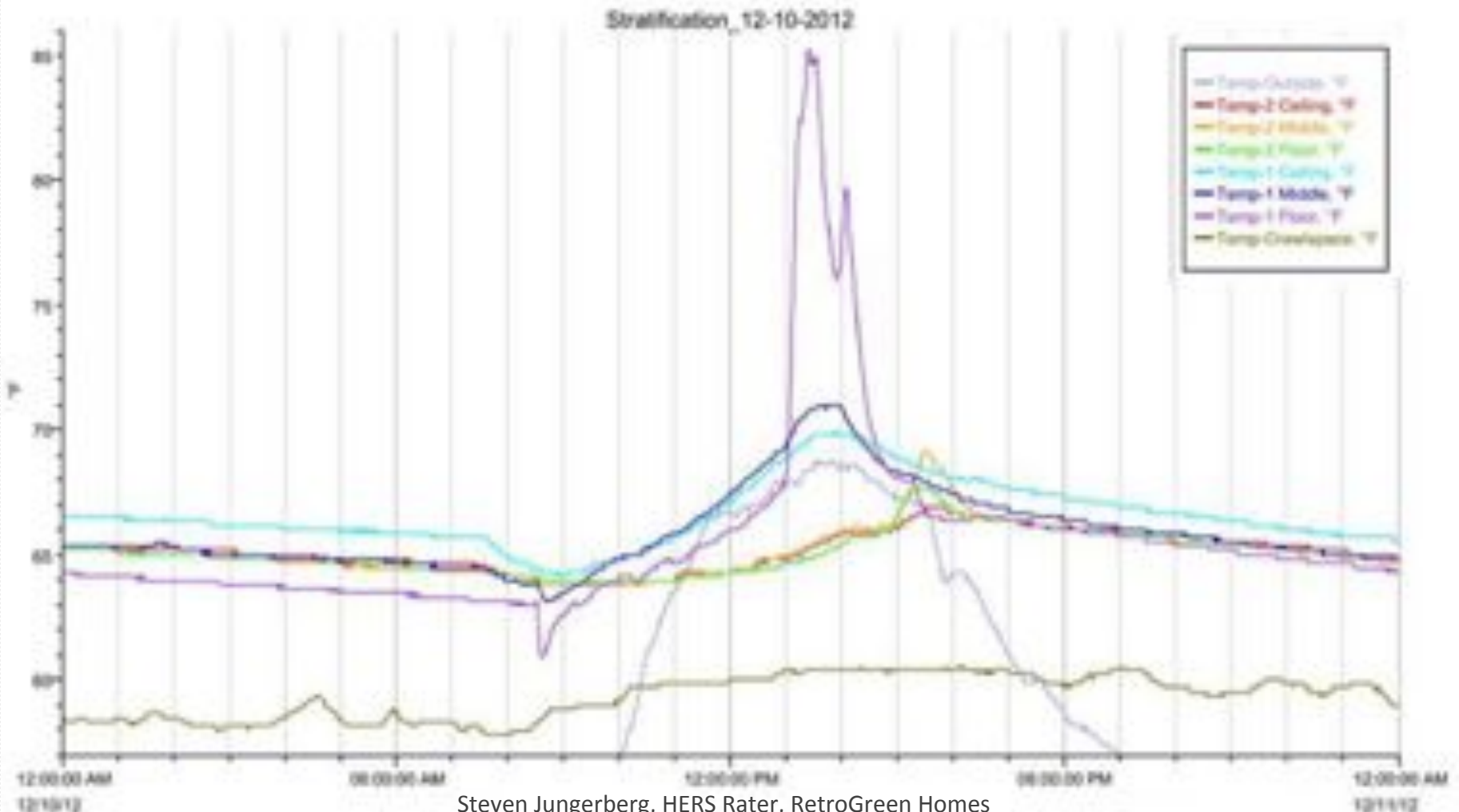
First, here is the graph of the HRV port temperatures over a 24 hour period. You can see how the low temperature incoming air (blue) is tempered by the outgoing interior air (red) to produce incoming air that is much closer to the interior air temperature (green).



Steven Jungerberg, HERS Rater
RetroGreen Homes

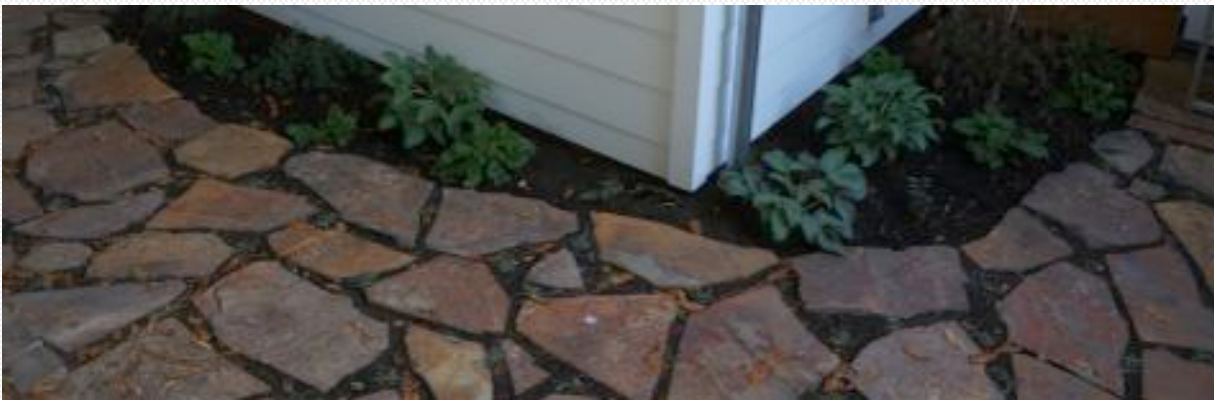
Monitoring: Temperatures

One of the valuable effects of the HRV is that the temperature of the house stays stable. Here is the graph of the temperatures outside, the crawlspace and top middle and bottom of each level of the house. Other than when there is sun moving through the house and affecting some of the data loggers more than the others, the temperature stays within 2-3°. This is a function of the stability of the Passive house design and the balancing effect of the HRV. It looks like the datalogger on the floor of level 1 got some direct sun for an hour or so.



Oh- LEED Platinum, too!

- Rainwater harvesting
- Drought-tolerant, native plants
- Salvaged wood flooring
- Low-VOC materials & finishes
- High-efficiency lighting & appliances
- Water-conserving fixtures
- On-demand hot water circulation



Tips + Lessons Learned

- Deliver intensive team training early
- Take control of windows
- Go passive solar—it really works
- SketchUp shading studies: just do it!
- Remember **peak load** certification option
- Ventilation: stay fully involved as design evolves
- *Other stuff: stay fully involved as design evolves!*

Questions?



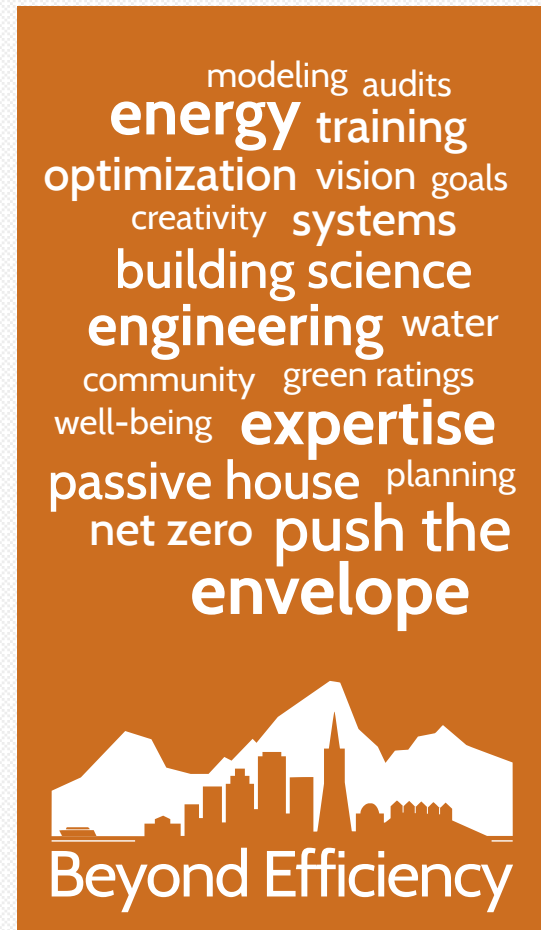
Push the envelope:

- Energy modeling & optimization studies
- High-performance envelope advising
- HVAC systems advising
- Green plan review & rating services
- Technical training & coaching
- Incentives program facilitation
- Contact:


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modeling audits
energy training
optimization vision goals
creativity systems
building science
engineering water
community green ratings
well-being **expertise**
passive house planning
net zero **push the**
envelope



Beyond Efficiency

