ORCHARDS AT ORENCO

Photo courtesy of Ankrom Moisan Architects and Casey Braunger

Owner's Motivation and Goals

- REACH has developed and managed affordable housing since 1982
- Today the portfolio has apartments for 2,073 individuals and families
- REACH's goal is to provide **Healthy, Safe,** and **Affordable** living
- Affordability not only includes low rents and close proximity to work and schools, but also the cost of **monthly utility bills**
- In 2010 Dee Walsh, the Executive Director visited Europe to see how they were building and managing Passive Affordable Housing
- Dee returned encouraged and motivated
- REACH set a goal to have a Passive House project in their portfolio by 2015

Project Team

REACH Community Development — *Owner/Developer*

Housing Development Center — *Owner's Representative*

Ankrom Moisan — *Architect of record*

WALSH Construction Co. — *General Contractor*

green hammer (Designed for People. Built for Life.) — *Passive House Consultant*

William Wilson Architects PC — *Design Architect*

PAE — *Mechanical Engineer*

STONEWOOD DESIGN — *Structural Engineer*

Humber Design Group, Inc. — *Civil Engineer*

WALKER MACY — *Landscape Architect*

earth advantage — *PHIUS+ Rater*

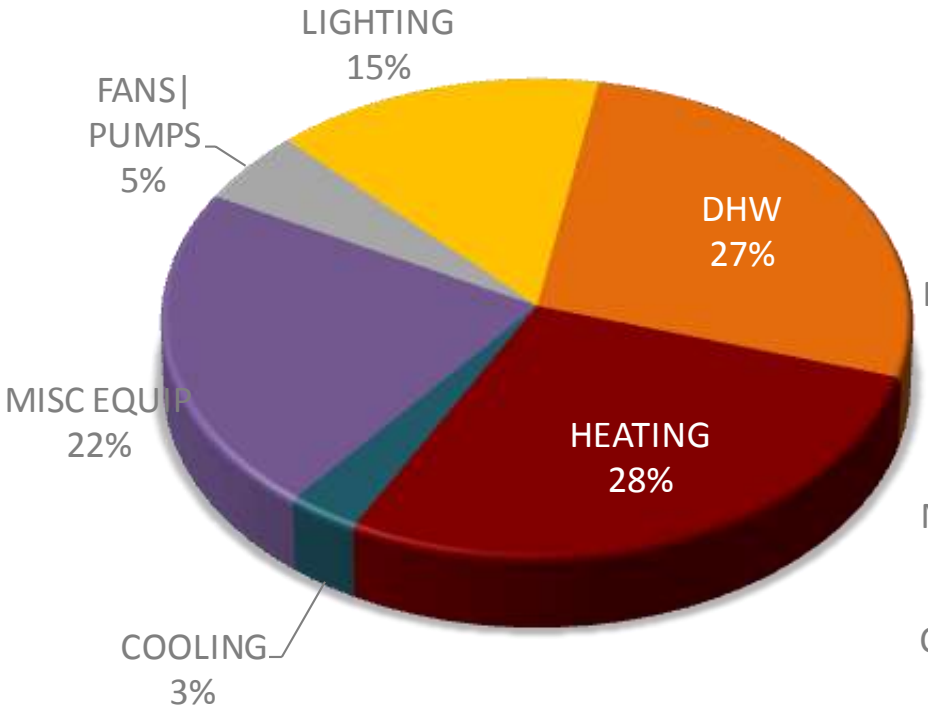
Location


INTEL
Central Park
Retail District
Neighborhood Center
Bus Line (48) and Stop
NE Cornell Rd
4 Acre Park
Sonrise Church
and Community
Garden
Quatama
Elementary
School
High Density
Residential
(HDR)
The Platform District
Senior Affordable
Housing
(HDR)
(HDR)
REACH
Phase 1
REACH
Phase 2
REACH
Phase 3
Orenco/NW 231st Ave MAX Stop
Bus Line (47) and Stop

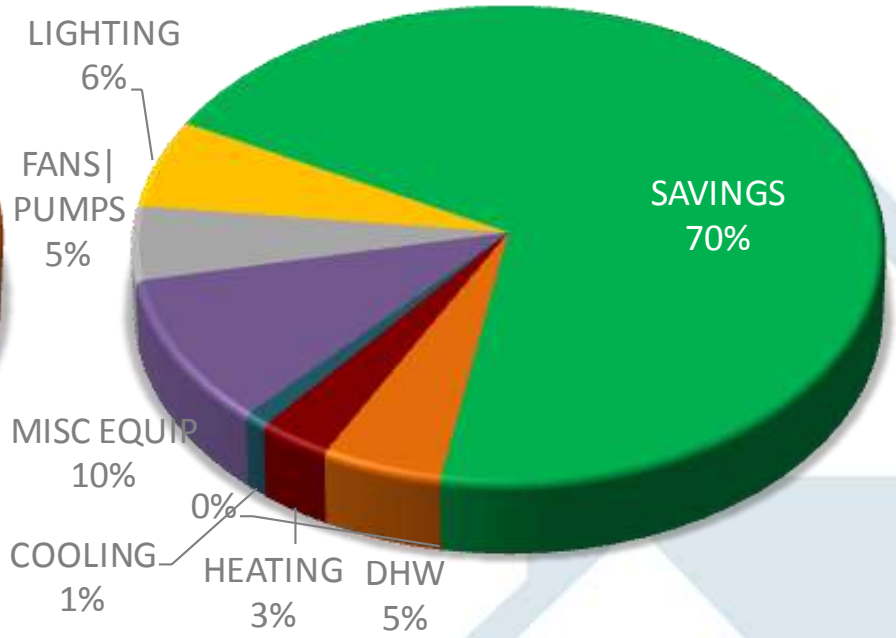
Project Overview

ENERGY USE COMPARISON

APARTMENTS



TYPICAL



TARGET

Passive House Approach

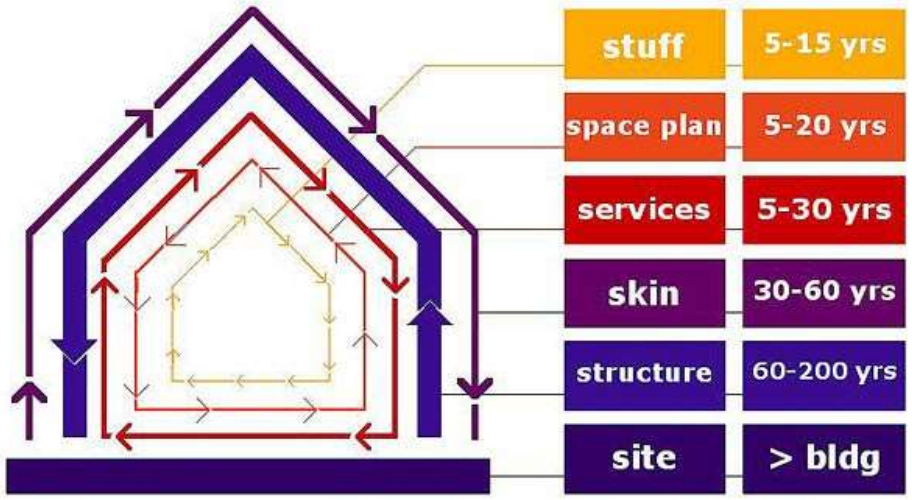
- Building designed to maximize cost-effective energy reduction
- Developed by team of German physicists in 1990's

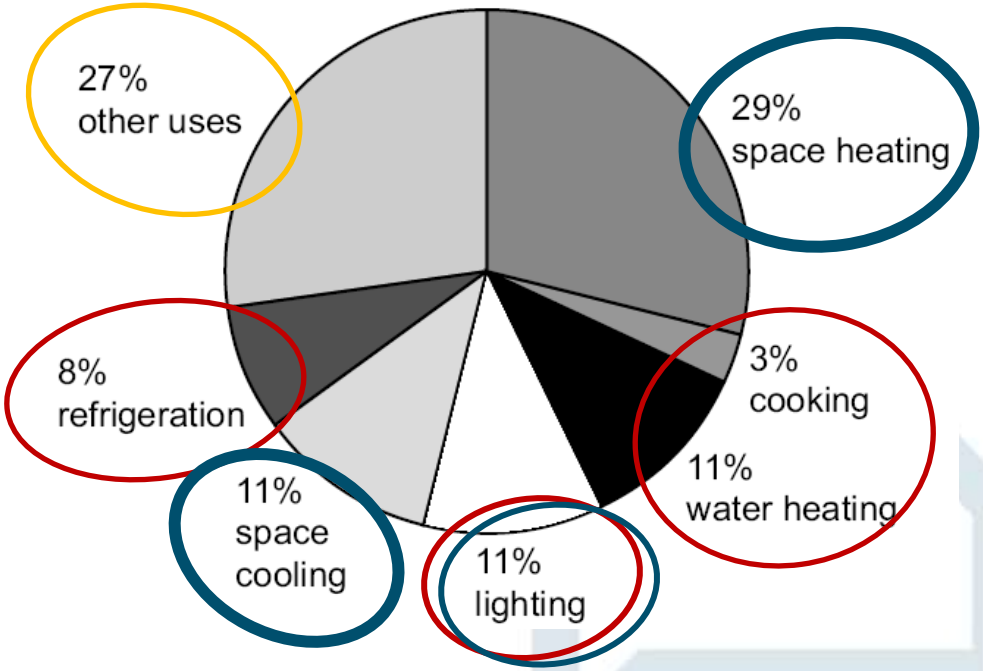
Invest in this…

~1000 W

…so we can heat with this amount of energy

Envelope Investment Opportunity





Residential Buildings

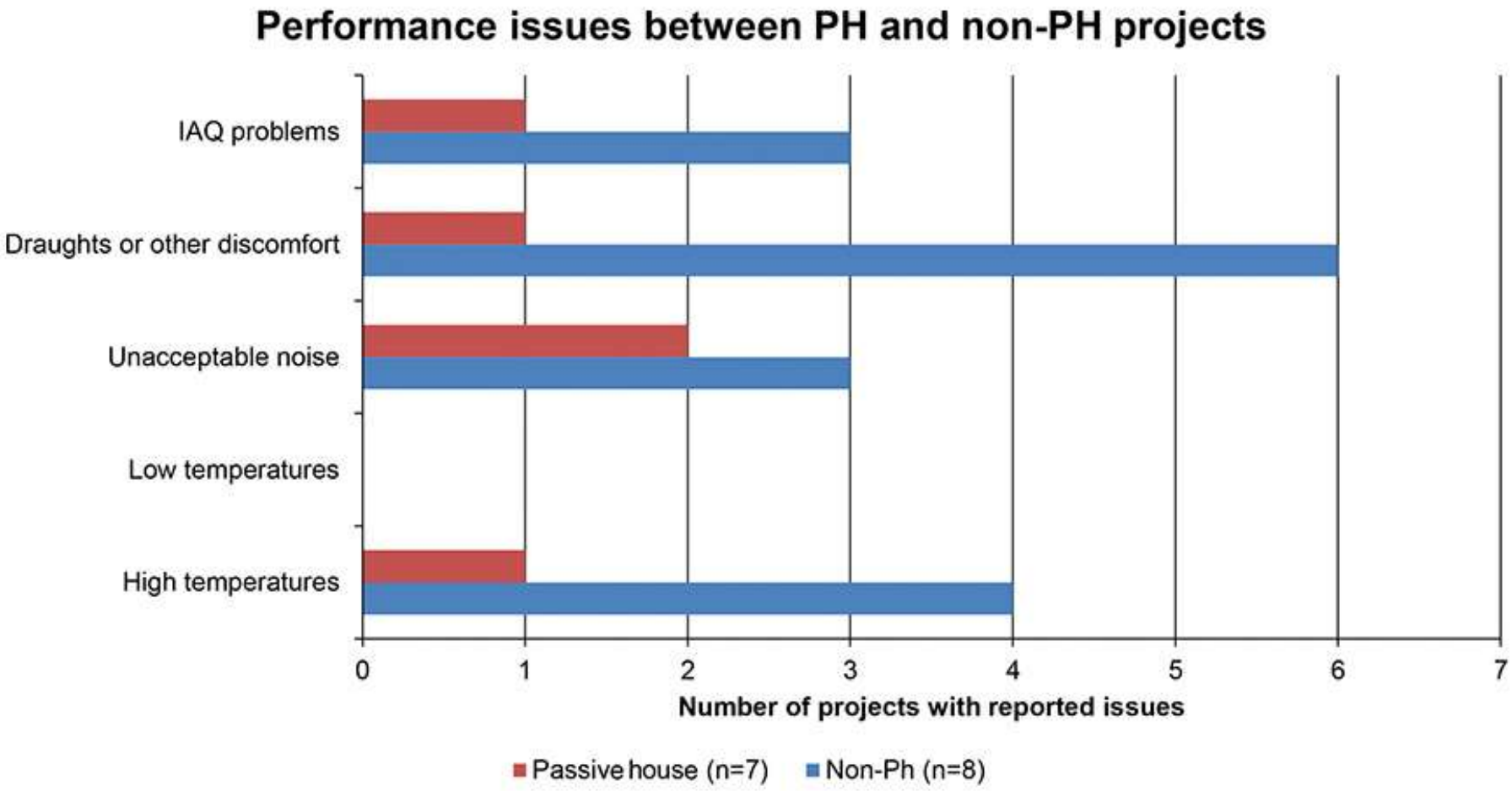
We generally have <u>one</u> opportunity to address 40-50% of a building's lifetime energy use

Address some serious global problems, while actually improving livability…

Passivhaus Benefits

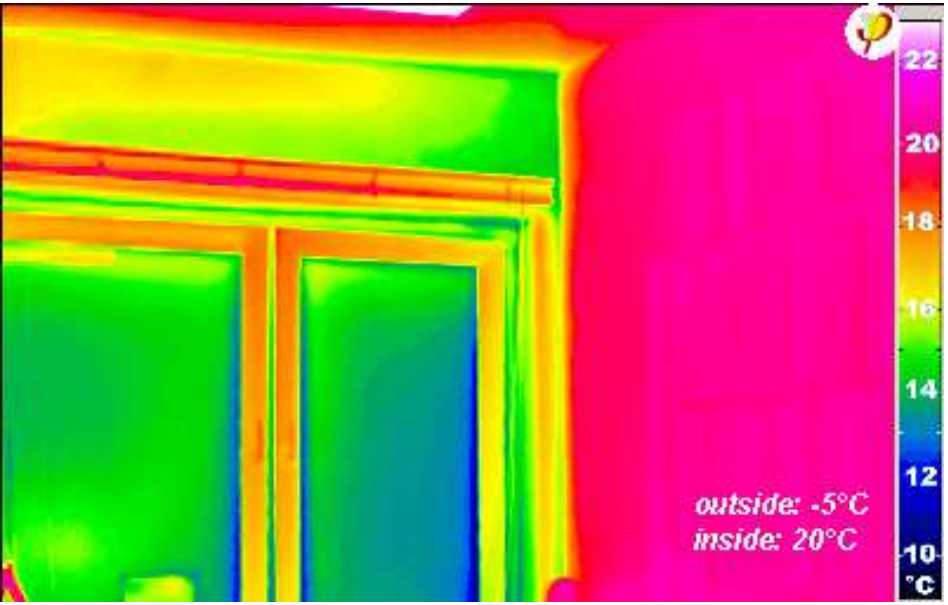
- Health
- Comfort
- Durability
- Resiliency
- Energy Savings

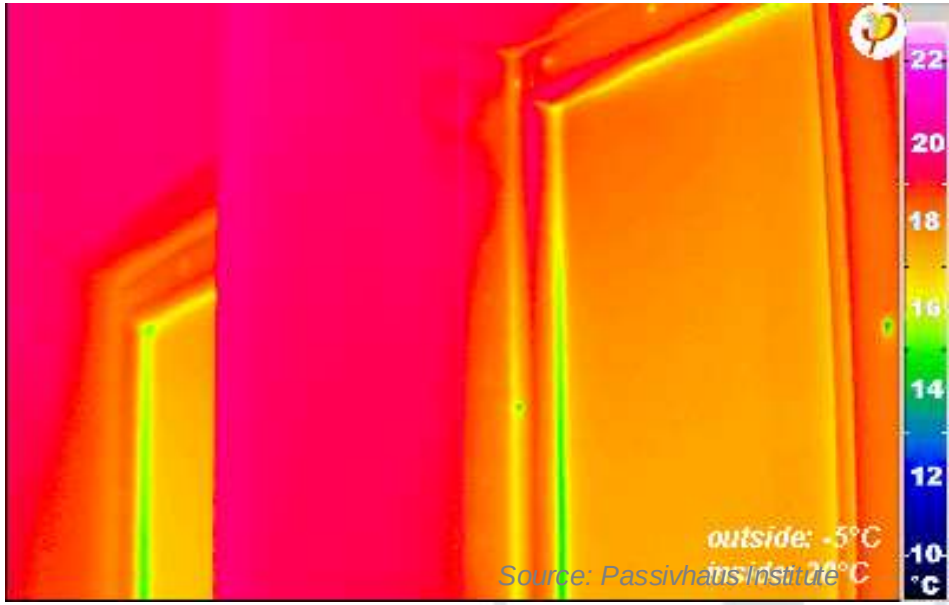
Superior Indoor Environmental Quality



Sharpe, TR. "An assessment of environmental conditions in bedrooms of contemporary low energy houses in Scotland" *Indoor & Built Environment*, May 2014

Superior Thermal Comfort





Source: Passivhaus Institute

Double-pane Window

Average surface temperature below 57 ° F
Thermal bridging at Installation Edge

Results in radiant temperature asymmetry, drafts, and cold air pockets in the room.

Passive House Window

Average surface temperature above 64 ° F
No thermal bridging

Uniform radiant temperatures, no drafts, no cold air pockets.

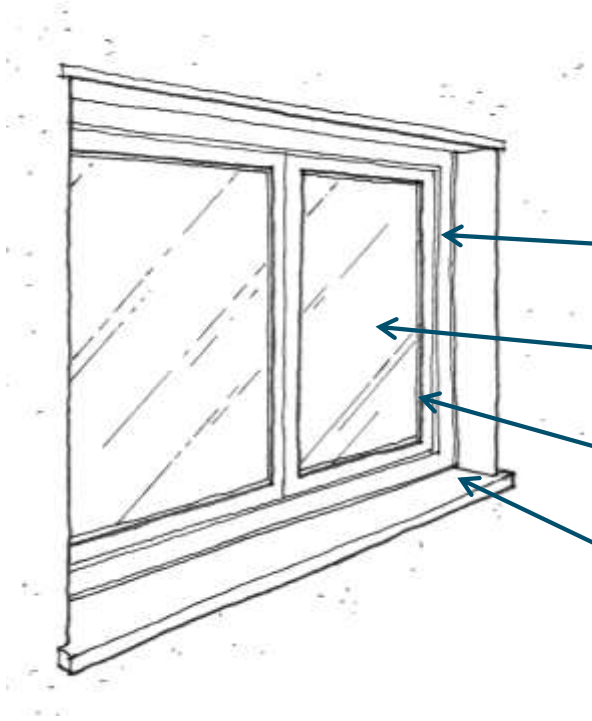
PHPP Modeling Tool

- "Simplified" energy modeling tool specific to highly-efficient buildings
- Based on Monthly average temperatures (No ETO Incentives)

Conventional Energy Modeling:

1 Input

U-window



PHPP:

4 Inputs

U-frame

U-glass

Ψ-spacer

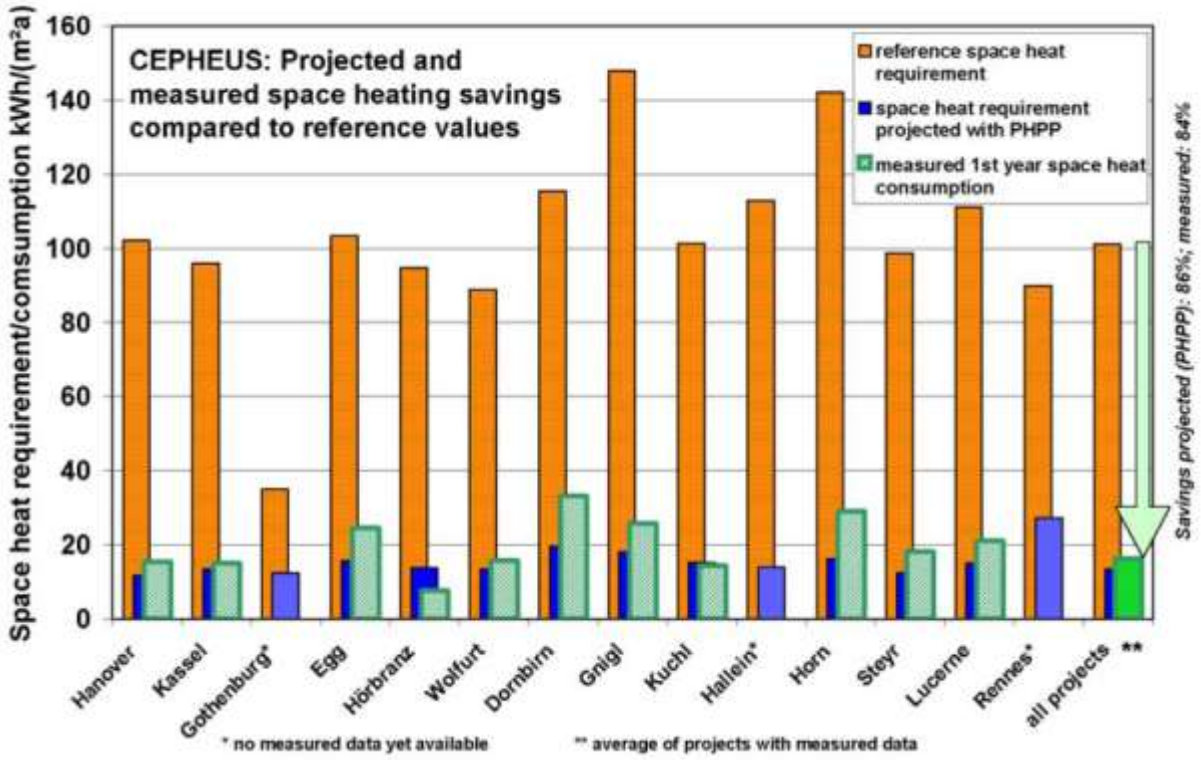
Ψ-install

PHPP Proof of Concept

- CEPHEUS Project, 1999-2000 sponsored by EU
- 14 projects totaling 221 housing units in 4 countries
- Verified: cost-effectiveness, different climates, PHPP accuracy, and occupant satisfaction

PHPP Proof of Concept

CEPHEUS Measurement Results



- PHPP predicted 86% Savings over Code (Heat Energy)
- 84% Savings verified from measured results
- Impressive track record for an energy simulation software based on monthly average temperatures

Passive House Standard

- Performance-based (not prescriptive)

- Three basic criteria:
  - Heating energy limit
  - Total source energy limit
  - Air-tightness

  Heating energy limit, Total source energy limit: PHPP model, third-party reviewed

  Air-tightness: third-party measurement on site

- High-efficiency heat recovery ventilation is necessary

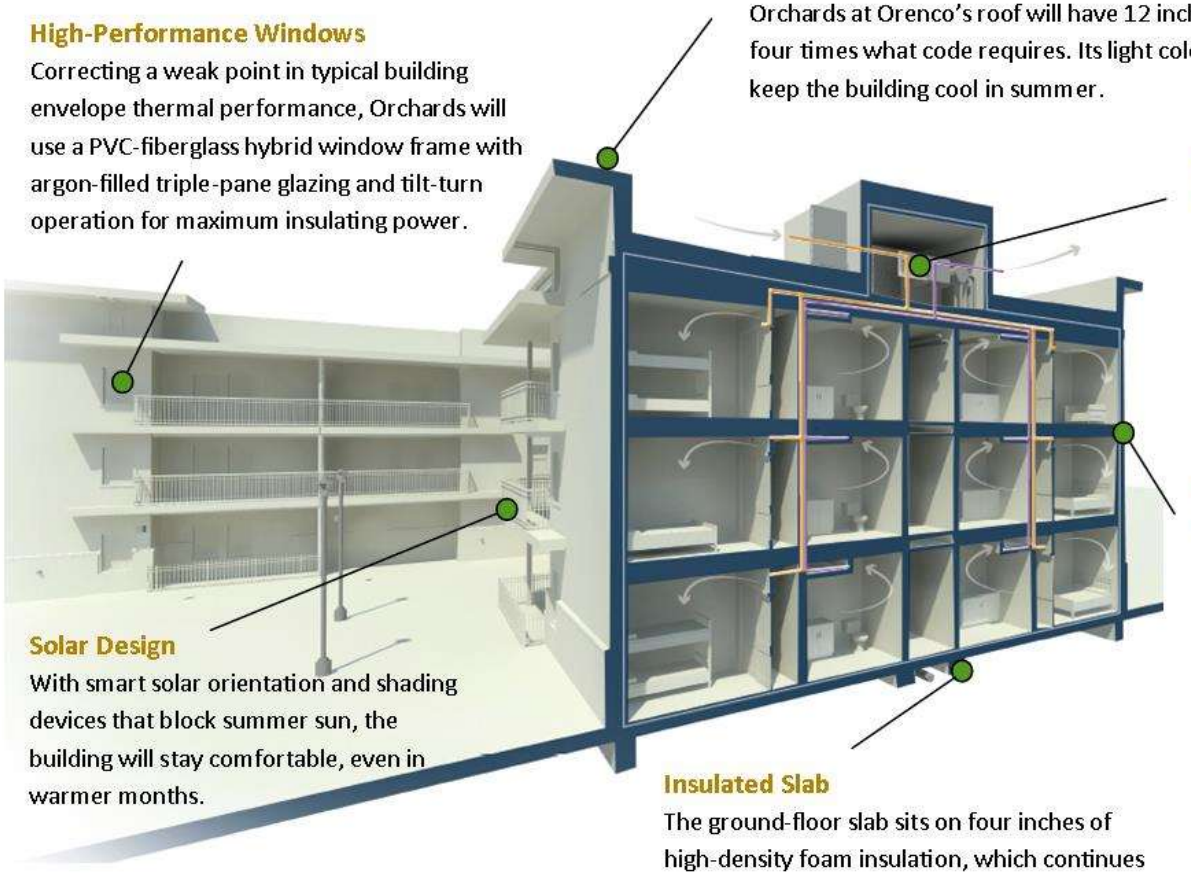
Certification process

- Passive House consultant, Green Hammer, engaged as design consultant
- Certification by Passive House Institute US (PHIUS)
- Precertification by groundbreaking
- PHIUS+ Rater, Earth Advantage, performed on site inspections and blower door testing
- Final Certification at the end of construction after blower door testing, ERV commissioning

Anatomy of a Passive House

High-Performance Windows
Correcting a weak point in typical building envelope thermal performance, Orchards will use a PVC-fiberglass hybrid window frame with argon-filled triple-pane glazing and tilt-turn operation for maximum insulating power.

Reflective Insulated Roof
Orchards at Orenco's roof will have 12 inches of insulation, about four times what code requires. Its light color will reflect sunlight to keep the building cool in summer.



Heat Recovery Ventilator
Stale air exhausted from kitchens and bathrooms will warm fresh incoming air, using otherwise wasted energy.

Super-Insulated Walls
Typical walls have 6-inch stud cavities filled with batt insulation; the walls at Orchards will have deeper 10-inch stud cavities filled with blown-in fiberglass insulation, plus a layer of rigid exterior insulation.

Solar Design
With smart solar orientation and shading devices that block summer sun, the building will stay comfortable, even in warmer months.

Insulated Slab
The ground-floor slab sits on four inches of high-density foam insulation, which continues under structural footings and wraps around the slab edge to meet the wall insulation.

Adapted from diagram by Ankrom Moisan Architects.

Building Design

Integrated Team / Integrative Approach

All core team members present on project from very beginning…

- Owner
- Design team
- Construction team
- Energy consultant

Design Charrette

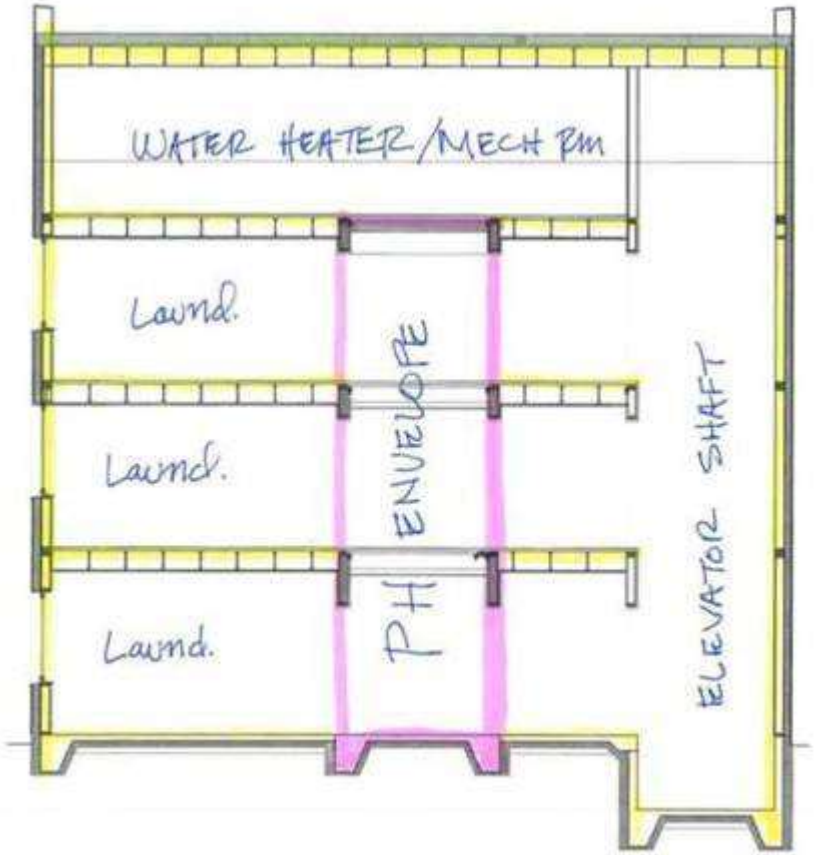
- Very early on during design process
- All core team members present, plus key stakeholders
- Established many key concepts for project heading out of the gate

Developing the Design

- Highly iterative process…
  - Design work → Modeling (PHPP) → Cost analysis → Constructability review
  - Repeat again…

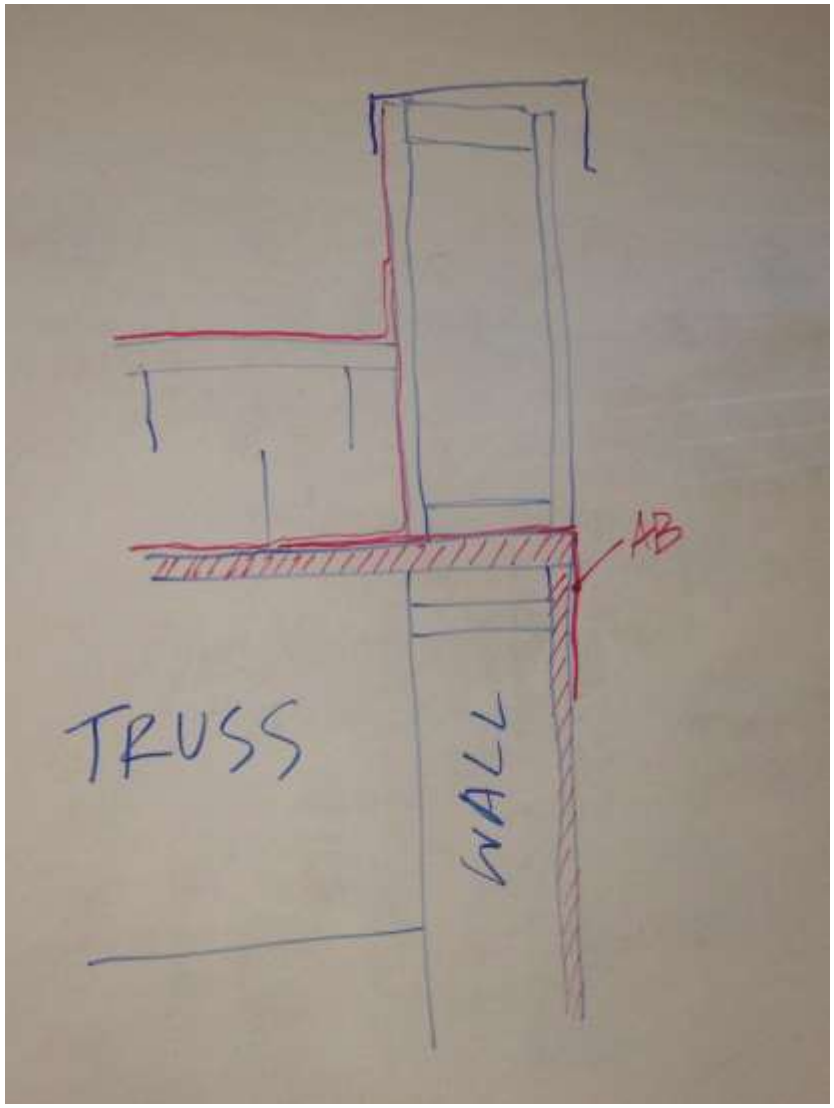
Building Design

Integrated Team / Integrated Approach



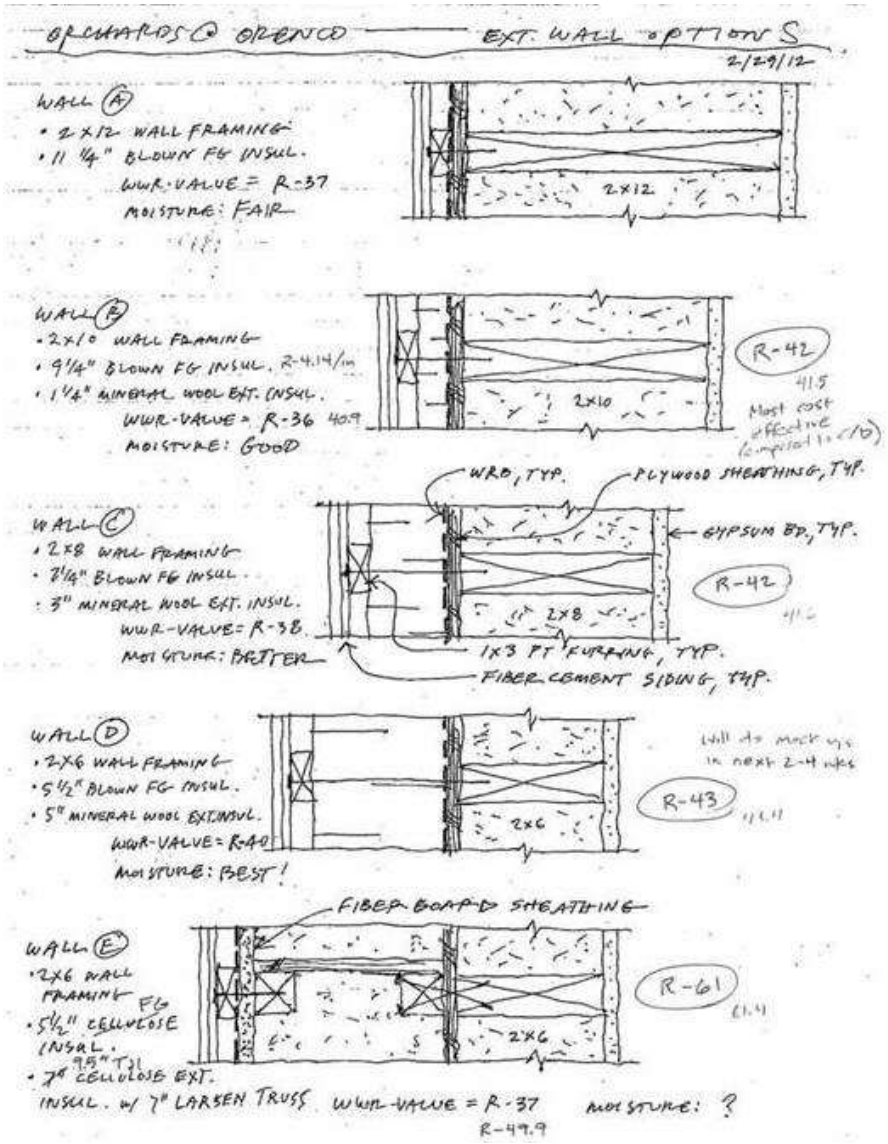
SCHEMATIC SECTION

Integrated Team / Integrated Approach



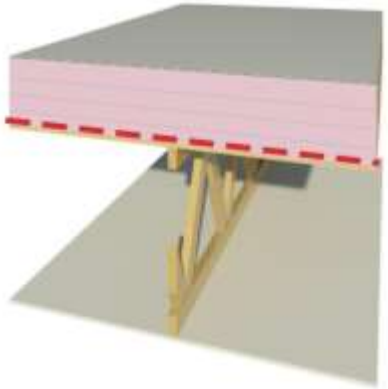
SCHEMATIC DETAILS

Building Design



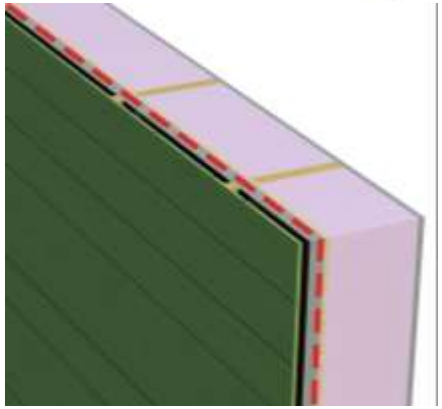
EXTERIOR WALL OPTIONS

Envelope Design



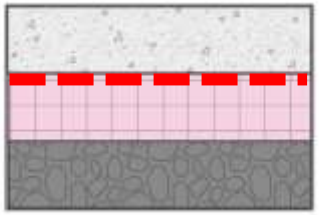
Typical Roof Assembly: R-81

- TPO Roofing Membrane (Fully adhered, White)
- ¼” Coverboard
- 12” Polyiso Insulation
- Temp Roof/Vapor Barrier
- ¾” Plywood w/ AB Tape at Seams (Air Barrier)
- Prefabricated Roof Truss
- 5/8” Gypsum Wall Board (2-layers)



Typical Exterior Wall Assembly: R-39

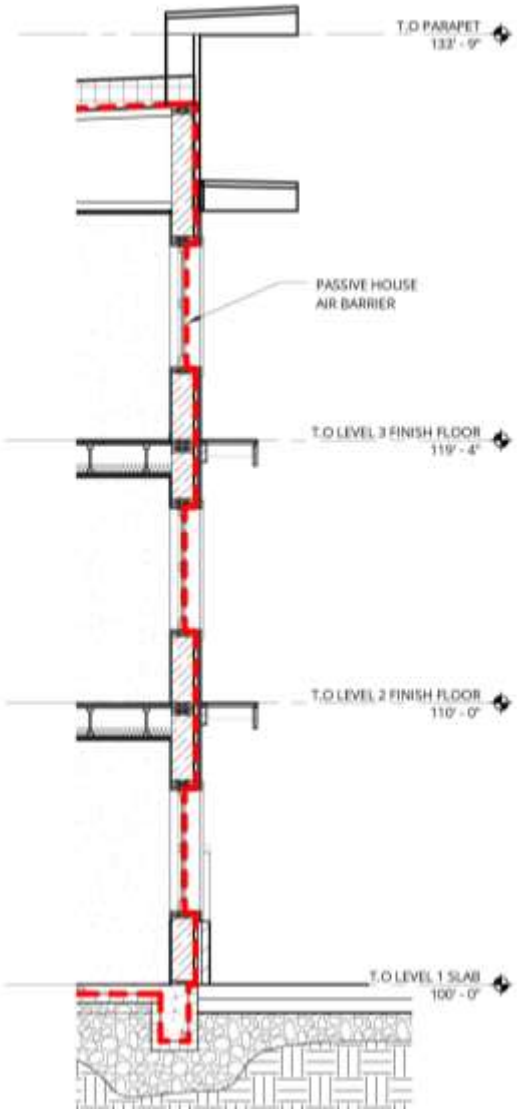
- Fiber cement siding w/ furring @ 24” o.c.
- 1-1/2” mineral fiber board insulation
- Building wrap weather barrier
- ½” Plywood w/ AB Tape at Seams (Air Barrier)
- 2x10 framing with blown-in fiberglass insulation
- Vapor barrier
- 5/8” Gypsum Wall Board



Typical Slab Assembly: R-19

- 4” Concrete Slab
- Vapor Retarder
- 4” EPS Insulation (continuous under perimeter footings and at slab edge)

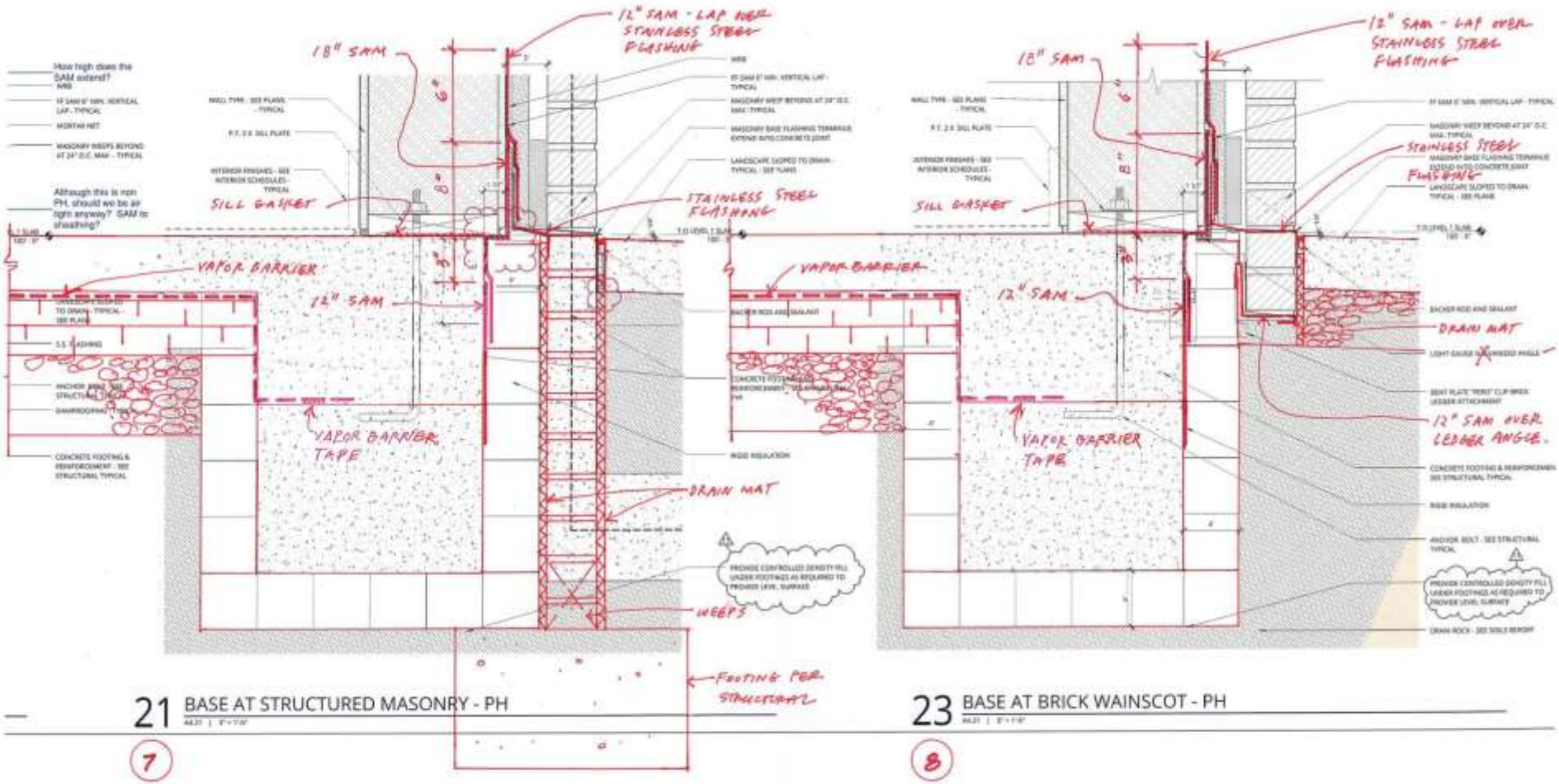
Envelope Design



Critical Details

- Wall/Roof tie-in
- Window/door head, sill, jamb
- Structural connection at balconies/shading devices
- Interface at Passive House/Non-Passive House zones
- Exterior footing to wall

Envelope Design



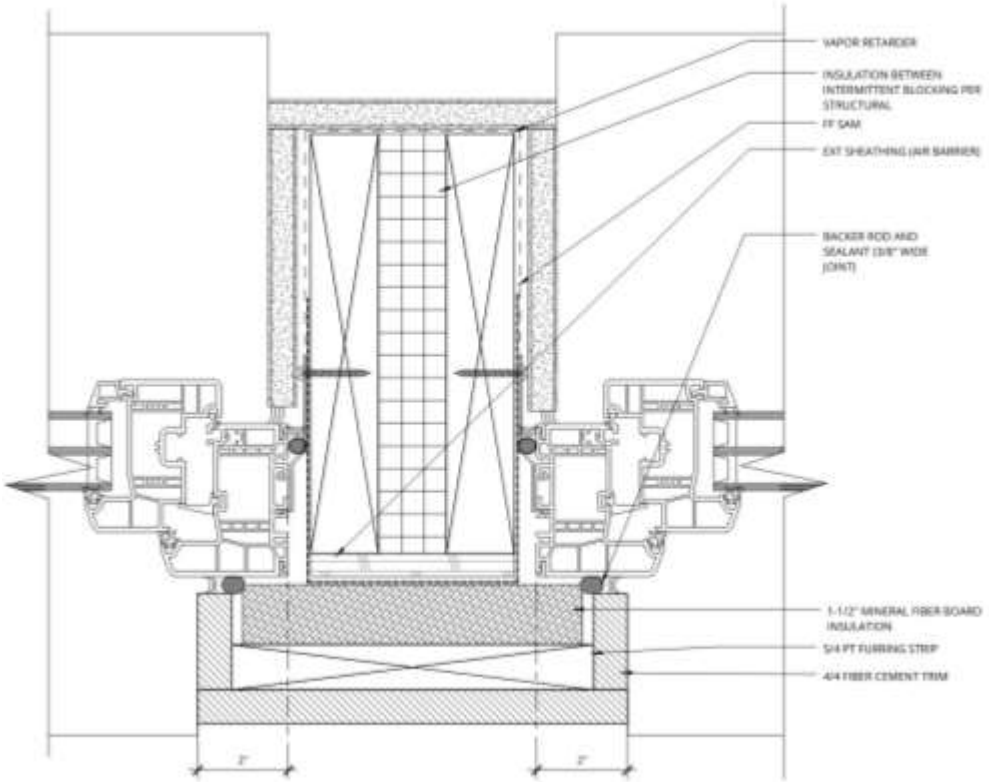
FOUNDATION COORDINATION DRAWINGS

7/29/2014


Protecto Wrap

Envelope Design

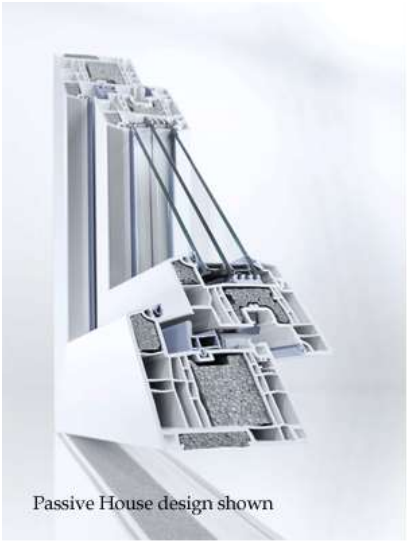
Reduce thermal bridging



Component Selection - Windows

WINDOW WISH LIST

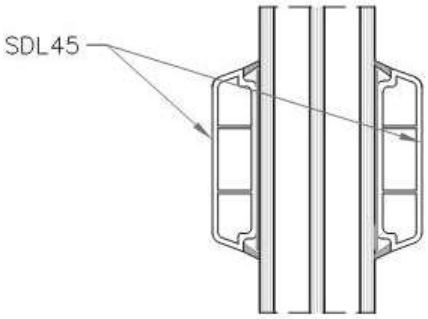
- Thermal Performance
- Airtight
- Watertight
- Affordable
- Locally Sourced



Euroline 4700 Series
U-0.16 BTU/hr.ft

Component Selection - Windows

Horizontal "Mullions"



2 HORIZONTAL SDL45 @ TRIPLE GLAZING
ARCH. REF:

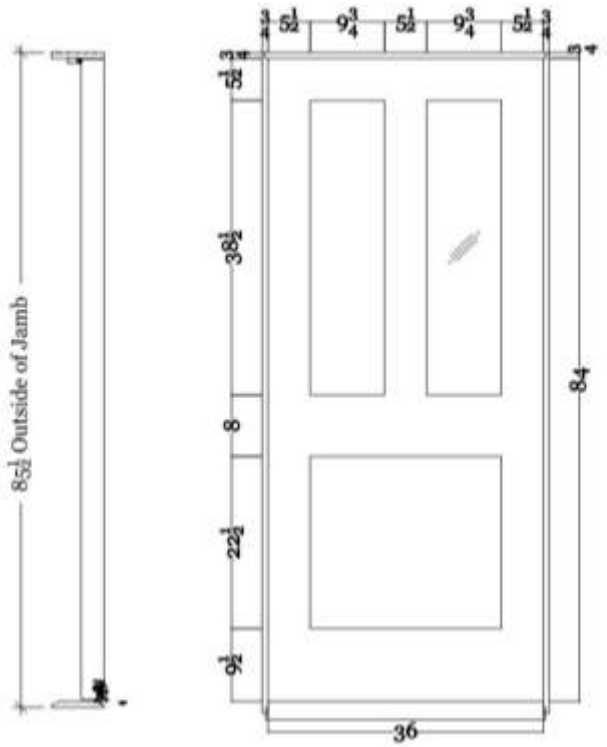
Component Selection - Doors

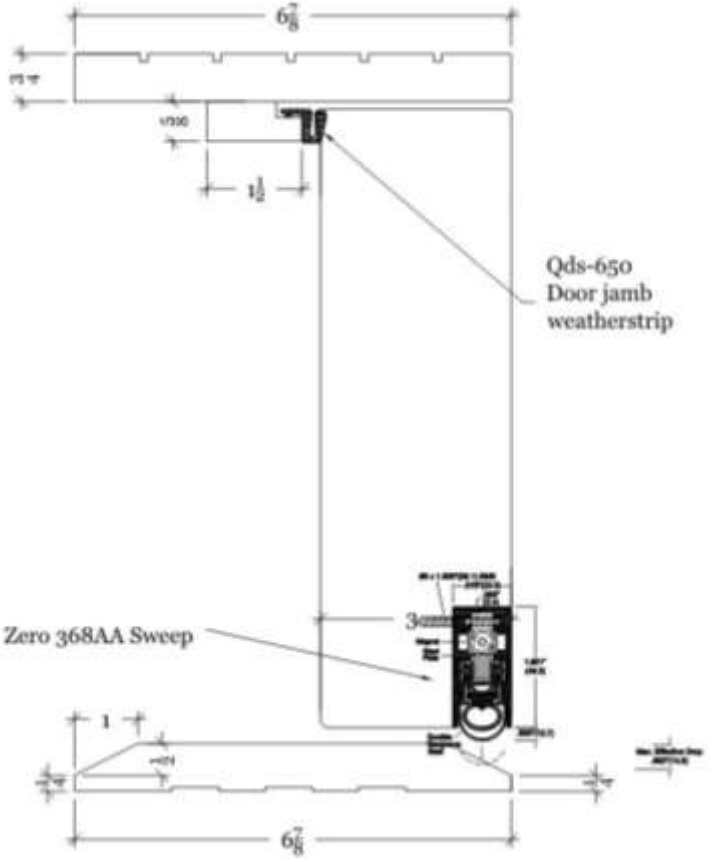
DOOR WISH LIST

- Thermal Performance
- Airtight
- Watertight
- Affordable
- Locally Sourced
- Appropriate for Commercial Use
- Work with a Key-fob System/Auto Door Opener
- Low Threshold Sill (per Fair Housing Act and UFAS standards)
- Fire-rated

Does not exist off the shelf

Component Selection - Doors

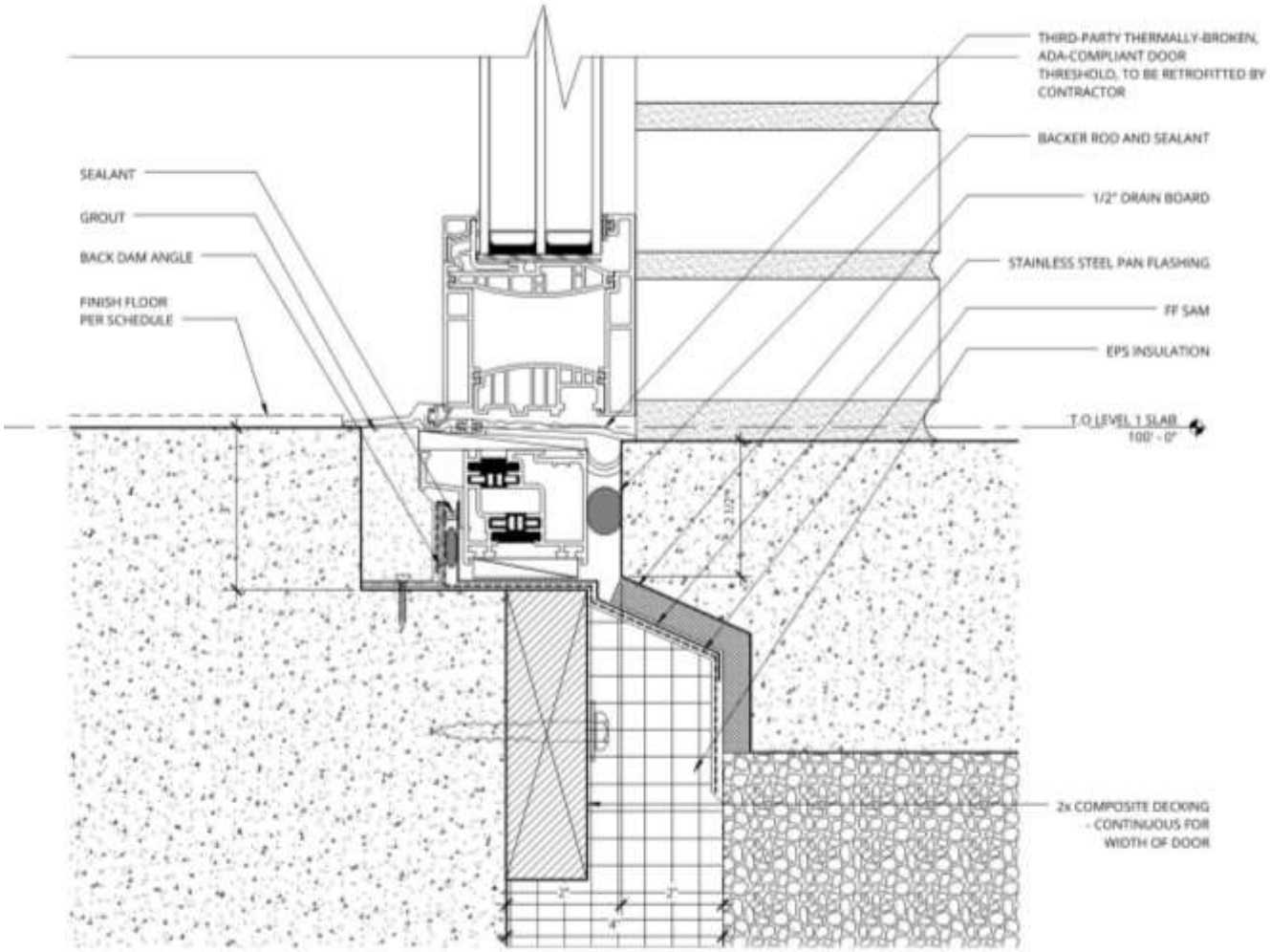




Custom Wood Door by Select Door

- 3” Solid Pine
- Custom UFAS/Fair Housing Act compliant threshold
- Drop Sweep

Component Selection - Doors



Entry Door Threshold Detail

Lighting & Appliances

Lighting Design/Considerations

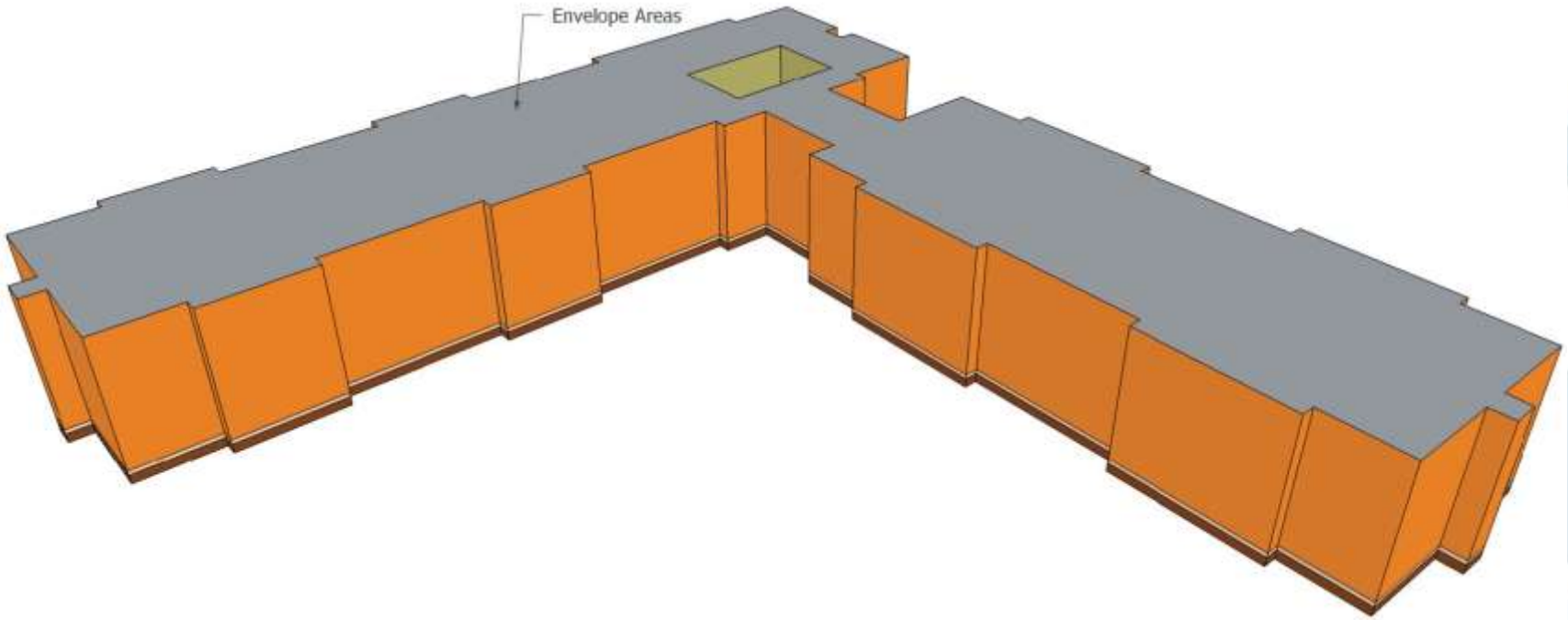
- Pinned fluorescent lighting in units
- LED lighting in common areas

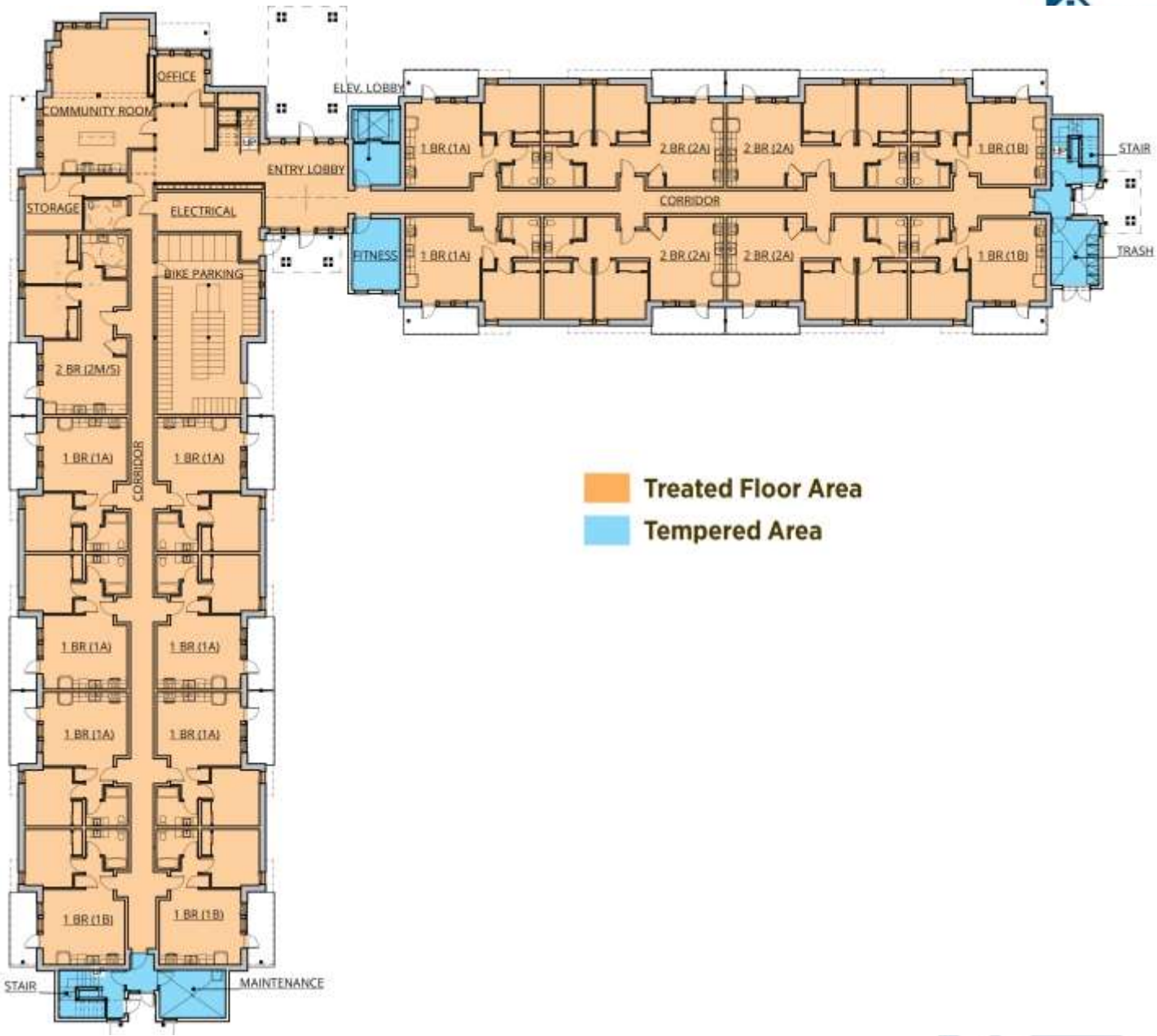
Appliance Considerations

- All appliances are provided to the tenant
- All appliances are Energy Star rated (REACH standard)
- Balancing energy budget, cost, and accessibility

Energy Analysis & Feedback

EARLY PLANNING: AVOID COMPLEXITY




OFFICE
COMMUNITY ROOM
ELEV. LOBBY
ENTRY LOBBY
STORAGE
ELECTRICAL
BIKE PARKING
FITNESS
1 BR (1A)
2 BR (2A)
2 BR (2A)
1 BR (1B)
STAIR
CORRIDOR
TRASH
2 BR (2M/S)
1 BR (1A)
1 BR (1A)
CORRIDOR
1 BR (1A)
1 BR (1A)
1 BR (1A)
1 BR (1A)
1 BR (1B)
1 BR (1B)
STAIR
MAINTENANCE
Treated Floor Area
Tempered Area

Energy Analysis & Feedback

SCHEMATIC DESIGN: "RANGE OF MOTION" STUDY

- Performance Based not Prescriptive: Heat Demand & Primary Energy Demand
- LOTS of Variables
- Keep a Healthy Contingency ("You don't know what you don't know")

Orenco Station Workforce Housing - Phase I
Passivhaus Energy Modeling

PHPP Schematic Design Iterations

1/19/2012

green hammer
DESIGN | BUILD | ENERGY
1323 SE 6th Avenue, Portland, Oregon 97214
503-804-1748

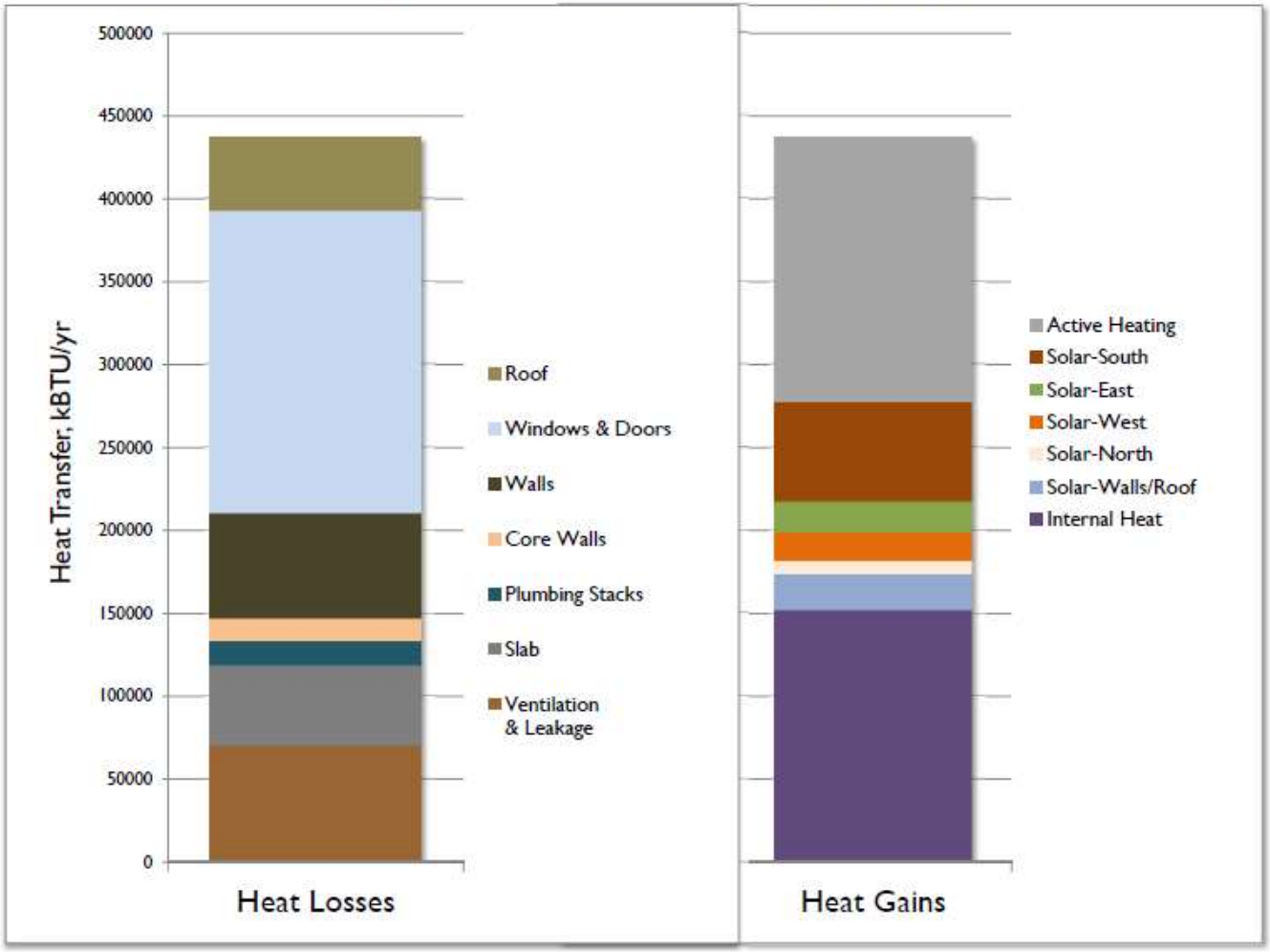
Iteration / Item	#1 Starting Point	R-value	#2 Keeping 2x8 wall	R-value	#3 Keeping Cascadia	R-value	#4 Revisiting Assumptions [Climate data adjustment]	R-value
Walls	2x8 w/ Cellulose	26	2x8 w/ Cellulose	26	2x4 + 9.5" Larsen Truss (Alt: 2x8 + 3" Polyiso)	47	2x8 w/ Cellulose	26
Window - typ size, apts	(2) 3 x 4 ft		(2) 3 x 4 ft		(1) 6 x 4 ft		(1) 6 x 4 ft	
Window - typ size, lobby	Flr-to-clg: 5ft tall view unit + 3ft tall oper clerestory		Ribbon: 2ft tall view unit + 2ft tall oper clerestory		Ribbon of 4 x 4 T/T		(1) 6 x 3 ft on North façade Ribbon of 4 x 4 T/T (3 ft North)	
Window:Wall Ratio, average	26%		23%		23%		22%	
Window - frame, apts	Cascadia 300 T/T	4.5	uPVC T/T	6.0	Cascadia 300 T/T	4.5	Cascadia 300 T/T	4.5
Window - frame, lobby	Cascadia 400+Framing	3.6	uPVC T/T	6.0	Cascadia 400+Framing	4.2	Cascadia 400+Framing	4.2
Window - glass south	LoE 180/180 Argon	7.5	EU IGU 0.5/0.5	11.4	LoE 180/180 Argon	7.5	LoE 180/180 Argon	7.5
Window - glass other	LoE 366/180 Argon	8.2	EU IGU 0.5/0.5 & 366/180	11.4	LoE 366/180 Argon	8.2	LoE 366/180 Argon	8.2
Doors - frame	Cascadia 301 T/T Door	4.7	uPVC T/T Door	5.9	Cascadia 301 T/T Door	4.7	Cascadia 301 T/T Door	4.7
Roof	6" EPS over Sheathing	31	10" EPS over Sheathing	49	10" EPS over Sheathing	49	10" EPS over Sheathing	49
Slab-field	Slab w 4" EPS	19	Slab w 6" EPS	29	Slab w 4" EPS	19	Slab w 4" EPS	19
Slab-footer	Slab w 2" EPS	9.3	Slab w 4" EPS	19.4	Slab w 2" EPS	10.3	Slab w 2" EPS	10.3
Slab-edge	Slab w 2" EPS	9.3	Slab w 4" EPS	19.4	Slab w 6" EPS	28.5	Slab w 6" EPS	28.5
Thermal Mass	Standard construction		Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet		Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet		Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet	
Ventilation Rate (ACH)	0.43		0.43		0.43		0.32	
HRV recovery efficiency	80%		90%		90%		90%	
HRV electrical efficiency (W/cfm)	0.75		0.75		0.75		0.75	
Other	Cellulose in Plumbing Stack		Cellulose in Plumbing Stack		Cellulose in Plumbing Stack		SPF in Plumbing Stack	
Heat Demand, Annual (kBTU/sf)	7.05		4.20		3.85		4.24	
Passivhaus Limit = 4.75 Recommend at this Stage = 4.0								
Heat Load, Whole Bldg (BTU/hr)	149000		114000		109000		115000	
% Htg Deliverable w/ Ventilation Air	112%		139%		145%		104%	
Cooling Strategy	HRV w/o heat recovery Windows open all hours		HRV w/o heat recovery Windows open all hours		HRV w/o heat recovery Windows open all hours		HRV w/o heat recovery Windows open night only	
Frequency of Overheating (>77°F) Recommend < 2%	4.3%		6.5%		6.1%		0.0%	

Heating Energy Analysis (Schematic)

Iteration #3

Annual Heat Demand (kBTU/sf.yr): 3.85

Envelope Thermal Gain & Loss, Heating Season



Dashboard Scenarios for Team Meetings

The Orchards at Orenco - Phase I
Passivhaus Energy Modeling

PHPP Schematic Design Results - CFC Application Iterations

3/14/2012

green hammer
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503-504-1746

Iteration	#7		#8			#9a		#9b		#9c		#10a		#10b		#10c	
Item	Thick Windows (New Window Schedule)	R-value	Thick Wall (New Window Schedule)	R-value		CFC App Iterations Wall B.C.D + Cascadia + 80cfm	R-value	CFC App Iterations Wall B.C.D + Cascadia + 60cfm	R-value	CFC App Iterations Wall B.C.D + Zola + 60cfm	R-value	CFC App Iterations Wall E + Cascadia + 80cfm	R-value	CFC App Iterations Wall E + Cascadia + 60cfm	R-value	CFC App Iterations Wall E + Zola + 60cfm	R-value
Walls	2x8 w/ Spray FG	28	2x6 w 5" Mineral Wool	43		Wall C: 2x8 + 3" Mineral Wool	42	Wall C: 2x8 + 3" Mineral Wool	42	Wall C: 2x8 + 3" Mineral Wool	42	Wall E: 2x6 + 9.5" TJI	61	Wall E: 2x6 + 9.5" TJI	61	Wall E: 2x6 + 9.5" TJI	61
Window - typ size, apts	3x5 ft T/T & Fixed		3x5 ft T/T & Fixed			3x5 ft T/T & Fixed		3x5 ft T/T & Fixed		3x5 ft T/T & Fixed		3x5 ft T/T & Fixed		3x5 ft T/T & Fixed		3x5 ft T/T & Fixed	
Window - typ size, lobby	Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T			Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T		Ribbon of 3x5 ft T/T	
Window - typ size, corridor end	(2) 3x5 ft		(2) 3x5 ft			(2) 3x5 ft		(2) 3x5 ft		(2) 3x5 ft		(2) 3x5 ft		(2) 3x5 ft		(2) 3x5 ft	
Window Wall Ratio, average	18%		18%			18%		18%		18%		18%		18%		18%	
Window - frame, apts	uPVC T/T	6.0	Casc 300 T/T overinsulated	4.5		Casc 300 T/T overinsulated	4.5	Casc 300 T/T overinsulated	4.5	uPVC T/T overinsulated	6.0	Casc 300 T/T overinsulated	4.5	Casc 300 T/T overinsulated	4.5	uPVC T/T overinsulated	6.0
Window - frame, lobby	uPVC T/T	6.0	Casc 400+300 overinsulated	4.2		Casc 300 T/T overinsulated	4.5	Casc 300 T/T overinsulated	4.5	uPVC T/T overinsulated	6.0	Casc 300 T/T overinsulated	4.5	Casc 300 T/T overinsulated	4.5	uPVC T/T overinsulated	6.0
Window - glass south	EU IGU 0.5/0.5	11.4	LoE 180/180 Argon	7.5		LoE 180/180 Argon	7.5	LoE 180/180 Argon	7.5	EU IGU 0.5/0.5	11.4	LoE 180/180 Argon	7.5	LoE 180/180 Argon	7.5	EU IGU 0.5/0.5	11.4
Window - glass north	EU IGU 0.5/0.5	11.4	LoE 366/180 Argon	8.2		LoE 180/180 Argon	7.5	LoE 180/180 Argon	7.5	EU IGU 0.5/0.5	11.4	LoE 180/180 Argon	7.5	LoE 180/180 Argon	7.5	EU IGU 0.5/0.5	11.4
Window - glass east	EU IGU 0.5 solar control	11.4	LoE 366/180 Argon	8.2		LoE 366/180 Argon	8.2	LoE 366/180 Argon	8.2	EU IGU 0.5 solar control	11.4	LoE 366/180 Argon	8.2	LoE 366/180 Argon	8.2	EU IGU 0.5 solar control	11.4
Window - glass west	EU IGU 0.5 solar control	11.4	LoE 366/180 Argon	8.2		LoE 366/180 Argon	8.2	LoE 366/180 Argon	8.2	EU IGU 0.5 solar control	11.4	LoE 366/180 Argon	8.2	LoE 366/180 Argon	8.2	EU IGU 0.5 solar control	11.4
Doors - frame	uPVC T/T Door	6.9	Casc 301 T/T Door overinsul	4.7		Casc 301 T/T Door overinsul	4.7	Casc 301 T/T Door overinsul	4.7	uPVC T/T Door overinsulated	6.9	Casc 301 T/T Door overinsul	4.7	Casc 301 T/T Door overinsul	4.7	uPVC T/T Door overinsulated	6.9
Roof	10" EPS over Sheathing	49	10" EPS over Sheathing	49		10" EPS over Sheathing	49	10" EPS over Sheathing	49	10" EPS over Sheathing	49	10" EPS over Sheathing	49	10" EPS over Sheathing	49	10" EPS over Sheathing	49
Slab-field	Slab w 4" EPS	19	Slab w 4" EPS	19		Slab w 4" EPS	19	Slab w 4" EPS	19	Slab w 4" EPS	19	Slab w 4" EPS	19	Slab w 4" EPS	19	Slab w 4" EPS	19
Slab-footer	Slab w 2" EPS	10	Slab w 2" EPS	10		Slab w 2" EPS	10	Slab w 2" EPS	10	Slab w 2" EPS	10	Slab w 2" EPS	10	Slab w 2" EPS	10	Slab w 2" EPS	10
Slab-edge	Slab w 6" EPS	29	Slab w 6" EPS	29		Slab w 6" EPS	29	Slab w 6" EPS	29	Slab w 6" EPS	29	Slab w 6" EPS	29	Slab w 6" EPS	29	Slab w 6" EPS	29
Thermal Mass	Dbl Drywall Walls & Ceilings Gyporete fir w/o carpet		Dbl Drywall Walls & Ceilings Gyporete fir w/o carpet			Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gyporete fir w/o carpet	
Ventilation Rate (ACH)	0.32		0.32			0.67 ACH		0.65 ACH		0.65 ACH		0.67 ACH		0.65 ACH		0.65 ACH	
Ventilation Rate (cfm per apt)						80 cfm/apt		60 cfm/apt		60 cfm/apt		80 cfm/apt		60 cfm/apt		60 cfm/apt	
HRV recovery efficiency	68% (Zehnder HRVs)		83% (Ultimate Air ERV)			83% (Ultimate Air ERV)		83% (Ultimate Air ERV)		83% (Ultimate Air ERV)		83% (Ultimate Air ERV)		83% (Ultimate Air ERV)		83% (Ultimate Air ERV)	
HRV electrical efficiency (W/cfm)	0.75		0.75			0.75 W/cfm		0.75 W/cfm		0.75 W/cfm		0.75 W/cfm		0.75 W/cfm		0.75 W/cfm	
Space Heating						80% Heat Pump, COP = 4.2 20% Direct Electric		80% Heat Pump, COP = 4.2 20% Direct Electric		80% Heat Pump, COP = 4.2 20% Direct Electric		80% Heat Pump, COP = 4.2 20% Direct Electric		80% Heat Pump, COP = 4.2 20% Direct Electric		80% Heat Pump, COP = 4.2 20% Direct Electric	
Water Heating						Gas Boiler, 93% eff. Tank loss 250 BTU/hr		Gas Boiler, 93% eff. Tank loss 250 BTU/hr		Gas Boiler, 93% eff. Tank loss 250 BTU/hr		Gas Boiler, 93% eff. Tank loss 250 BTU/hr		Gas Boiler, 93% eff. Tank loss 250 BTU/hr		Gas Boiler, 93% eff. Tank loss 250 BTU/hr	
Other	SPF in Plumbing Stack		SPF in Plumbing Stack			Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (6) 2x12, 24" stud bays filled with SPF	
Heat Demand, Annual (kBTU/sf)	**3.83**		**3.82**			**5.51 kBTU/sf.yr**		**4.88 kBTU/sf.yr**		**4.66 kBTU/sf.yr**		**4.92 kBTU/sf.yr**		**4.30 kBTU/sf.yr**		**3.52 kBTU/sf.yr**	
Passivhaus Limit = 4.75 Recommend at this Stage = 3.8																	
Heat Load, Whole Bldg (BTU/hr)	104395		103183			112789 BTU/hr		105356 BTU/hr		95852 BTU/hr		105549 BTU/hr		98117 BTU/hr		88412 BTU/hr	
% Htg Deliverable w/ Ventilation Air	116%		121%			287%		230%		254%		307%		247%		275%	
Cooling Strategy	HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only			HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only	
Frequency of Overheating (>77°F) Recommend 0% for whole bldg	0.0%		0.0%			0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Primary Energy, Annual* (kWh/sf.yr) With Solar Thermal Collectors Passivhaus Limit = 11.1 Recommend at this Stage = 8.9						**11.1 kWh/sf.yr** 9.0 kWh/sf.yr		**10.3 kWh/sf.yr** 8.1 kWh/sf.yr		**10.1 kWh/sf.yr** 8.0 kWh/sf.yr		**10.9 kWh/sf.yr** 9.7 kWh/sf.yr		**10.1 kWh/sf.yr** 9.0 kWh/sf.yr		**9.0 kWh/sf.yr** 8.7 kWh/sf.yr	
												Annual Heat Demand with 12" Polyiso Roof: **4.47 kBTU/sf.yr**		Annual Heat Demand with 12" Polyiso Roof: **3.86 kBTU/sf.yr**			

UPDATED CLIMATE DATA, ENVELOPE, & FLOOR AREA, THERMAL MASS, APPLIANCE & LIGHTING CALCULATIONS

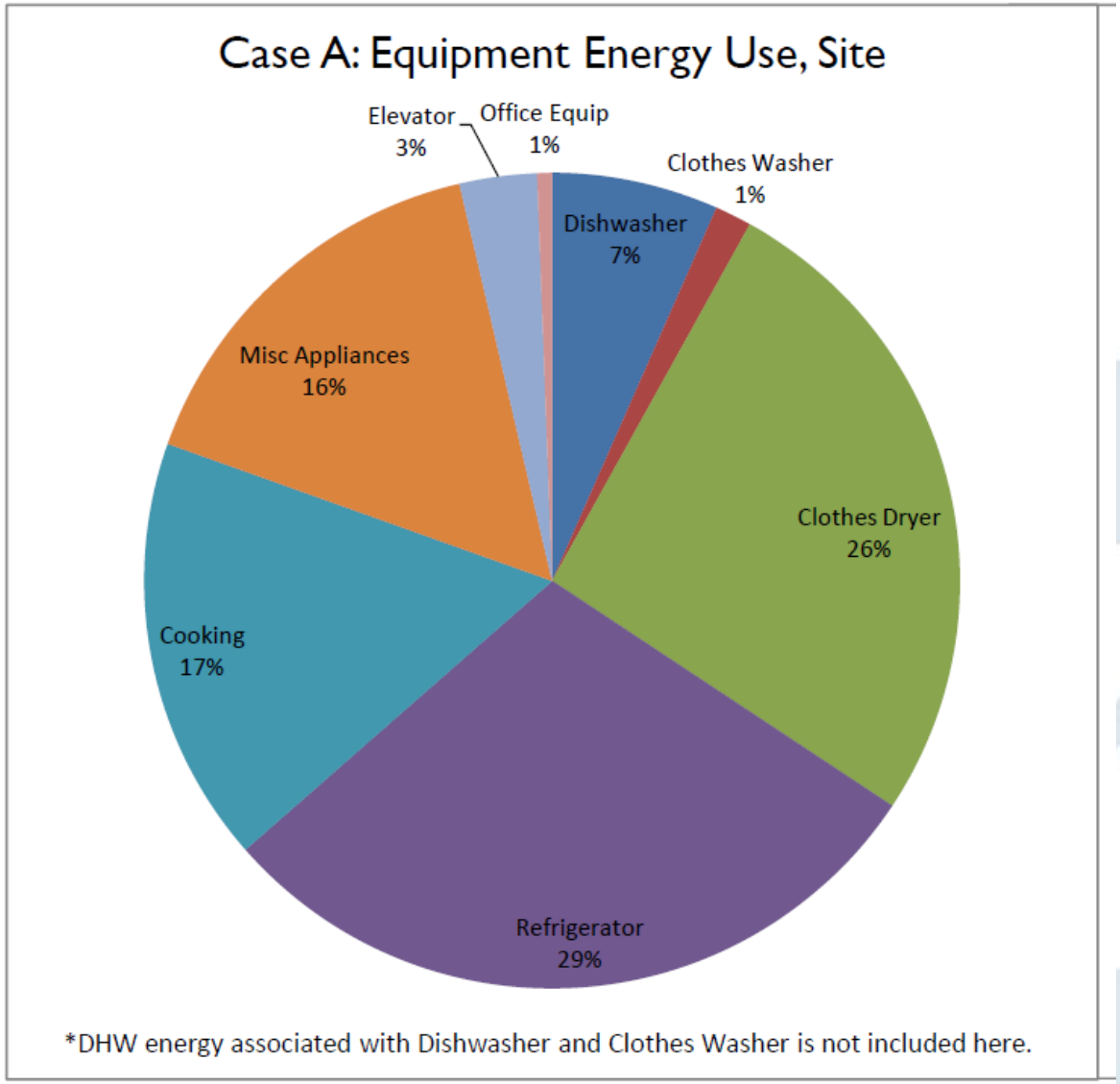
* Data assumes PHPP default values for lighting, appliance and plug loads. Actual anticipated loads are over twice these values and will not meet the Primary Energy standard.

Narrowing In…

…but ……holding 20% contingency

e	#5 Thick Windows	R-value	#6 Thick Wall	R-value
	2x8 w/ Spray FG	28	2x6 w 4" Mineral Wool	39
	(1) 6 x 4 ft Ribbon of 4 x 4 T/T Single 4x4 T/T 24% uPVC T/T uPVC T/T EU IGU 0.5/0.5 EU IGU 0.5/0.5 LoE 366/180 Argon LoE 366/180 Argon uPVC T/T Door	 6.0 6.0 11.4 11.4 8.2 8.2 5.9	(2) 3 x 4 ft Ribbon of 4 x 4 T/T Single 4x4 T/T 24% Cascadia 300 T/T Casc 400+300 (no framing) LoE 180/180 Argon LoE 366/180 Argon LoE 366/180 Argon LoE 366/180 Argon Cascadia 301 T/T Door	 4.5 4.2 7.5 8.2 8.2 8.2 4.7
	6" EPS over Sheathing	31	10" EPS over Sheathing	49
	Slab w 4" EPS Slab w 2" EPS Slab w 6" EPS	19 10 29	Slab w 4" EPS Slab w 2" EPS Slab w 6" EPS	19 10 29
	Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet		Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet	
	0.32 90% 0.75		0.32 90% 0.75	
	SPF in Plumbing Stack		SPF in Plumbing Stack	
	3.66 110438 108%		3.59 103814 115%	
	HRV w/o heat recovery Windows open night only		HRV w/o heat recovery Windows open night only	

Equipment Energy Use Breakdown



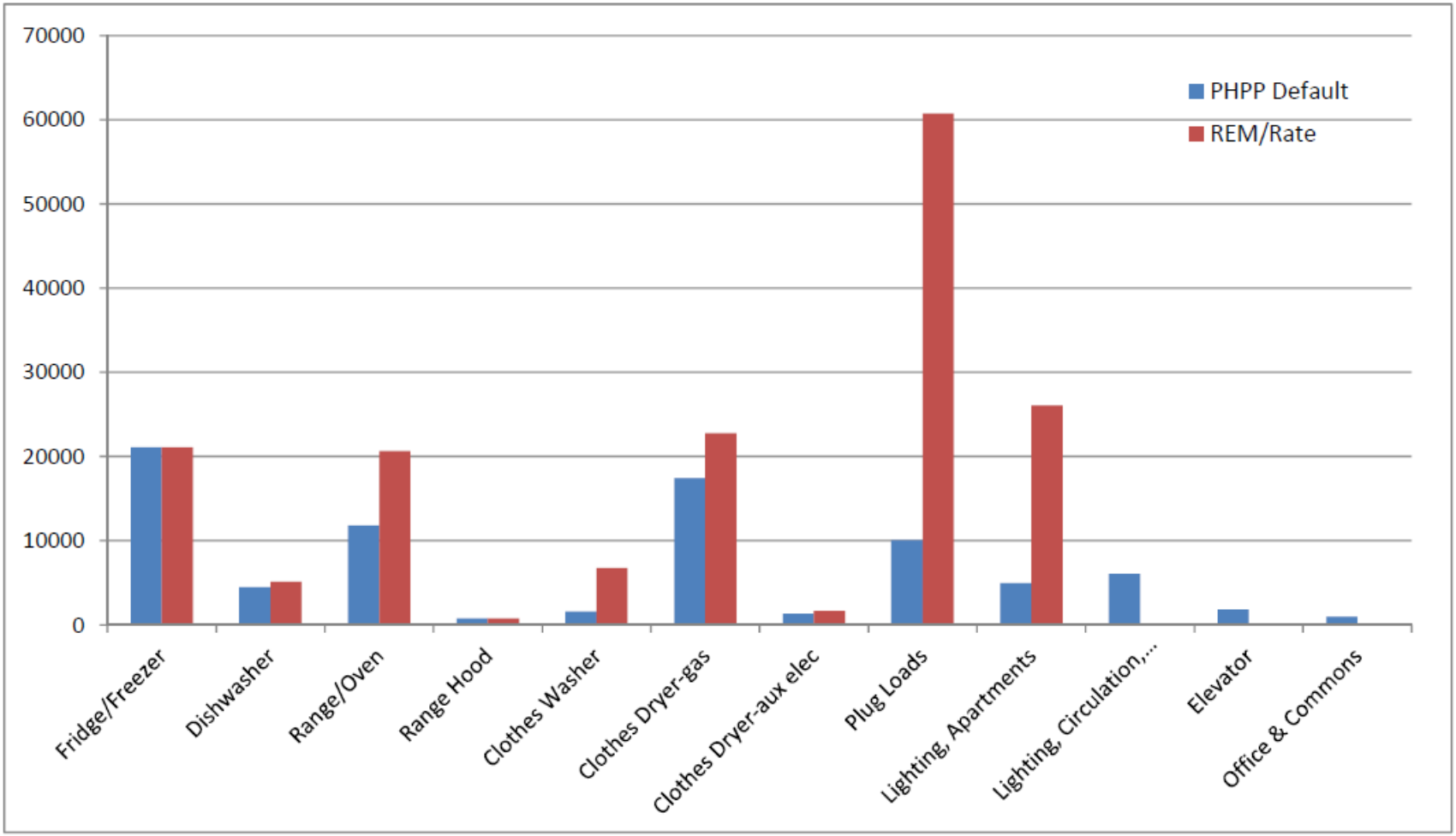
Narrowing in on Appliance "Energy Budgets"…

PHPP Appliance Energy Use Specification

9/9/2014

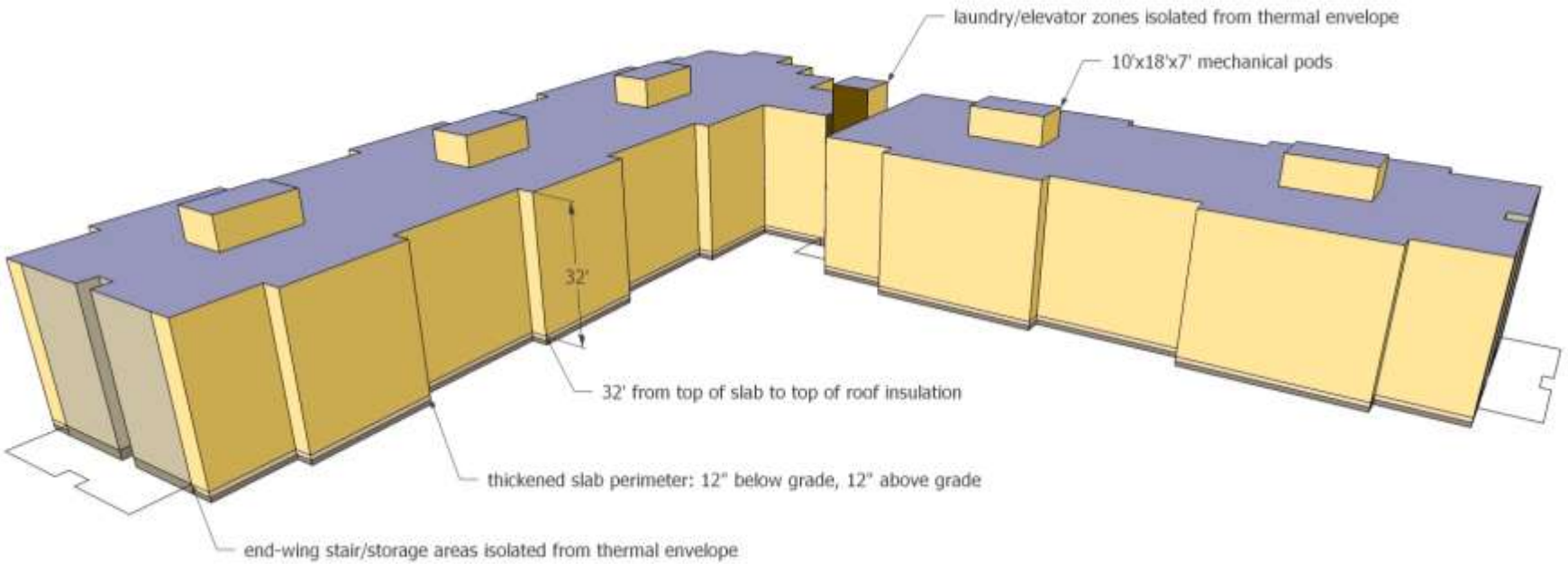
	BETTER			BEST		
	Energy Use		Note	Energy Use		Note
Apartments						
Fridge/Freezer	383	kWh/yr	50th percentile Energy Star units	335	kWh/yr	10th percentile Energy Star units
Dishwasher	303	kWh/yr	50th percentile Energy Star units	259	kWh/yr	10th percentile Energy Star units
Stovetop			Electric coil			Electric induction (ferrous cookware only)
Oven			Electric			Electric, Convection
Ceiling Fan			Energy Star			ECM, (ie. Emerson Midway Eco)
Common Areas						
Clothes Washer	141	kWh/yr	50th percentile Energy Star units	108	kWh/yr	10th percentile Energy Star units
						Commercial Heat Pump Dryer Available?
Elevator	5000	kWh/yr	Traction, geared	1800	kWh/yr	MRL Traction

Reality check on Plug Loads…



DETAILED DESIGN: NARROWING IN

- Vetting Component Selections
- Tighten Contingency as more becomes Known



DETAILED DESIGN: NARROWING IN

The Orchards at Orenco - Phase I

Passivhaus Energy Analysis Update

For Passivhaus Certification Purposes Only

5/1/2012

1323 SE 6th Av

RESULTS:					
Space Heating EUI:	3.60	kBTU/sf.yr	Total Source Energy EUI:	33.9	kBTU/sf.yr
Passivhaus Standard:	4.75	kBTU/sf.yr	Passivhaus Standard:	38.0	kBTU/sf.yr
Percent of Limit:	76%		Percent of Limit:	89%	

ASSUMPTIONS:

Envelope:

		R-value
Walls:	Wall B: 2x10 + 1.25" mineral wool	42
Windows:	uPVC T/T overinsulated	6.0
Glazing:	EU 3-Pane IGU 0.5/0.5	11
Doors:	uPVC T/T Door overinsulated	5.9
Glazing:	EU 3-Pane IGU 0.5/0.5	11
Solid Doors:	Insulated	5.9
Roof:	Slab w 4" EPS	19
Slab:	Slab w 6" EPS	29
Under Footer:	0	0
Over Edge:	0	15
Airtightness:	0.6 ACH @ 50 Pa	

Other:

Thermal Mass:	Dbl 5/8" drywall, major walls & ceilings
	1 1/2" gypcrete floor topping w/o carpet
Cold Stacks:	Downspouts, Plumbing vents aggregated in:
	(8) 2x12, 24" stud bays filled with SPF

Heating System: 80% Heat Pump, COP=4.2
delivered via HRV supply
20% Direct Electric (in apartments)

Ventilation System: Ultimate Air ERV, 83% eff, 0.75 W/cfm

Apartment Ventilation:	50 cfm/apt
Comm. Rm. Ventilation:	0.35 ACH
Circulation Ventilation:	0.06 cfm/sf
Whole-Building Ave:	0.60 ACH
Duct Insulation, HRV to Exterior:	4" FG w/ vapor barrier

DHW System: Gas Boiler, 93% efficient

Hot Line Insulation:	min. 1 1/2" continuous
Tank Insulation:	best available

Central or Decentralized Tank locations are possible

Cooling Strategy: Windows open night only, closed during day
Lobby stack ventilation
HRV w/o heat recovery

Appliances:

Refrigerator/Freezers:	370 kWh/yr ES rating or
Dishwashers:	275 kWh/yr ES rating or
Clotheswashers:	184 kWh/yr ES rating or
Clothesdryers:	gas (moisture sensing recommen
Range/Oven:	electric (convection recommend
Range Hood:	recirculating
Elevator:	1800 kWh/yr
	i.e. Kone Ecospace, MRL Tractio

Lighting:

Residential:	100% fluorescent
Non-residential:	0.8 W/sf occupied areas
	0.4 W/sf storage/circulation area
	occupancy sensing all non-reside

DETAILED DESIGN: NARROWING IN

The Orchards at Orenco - Phase I

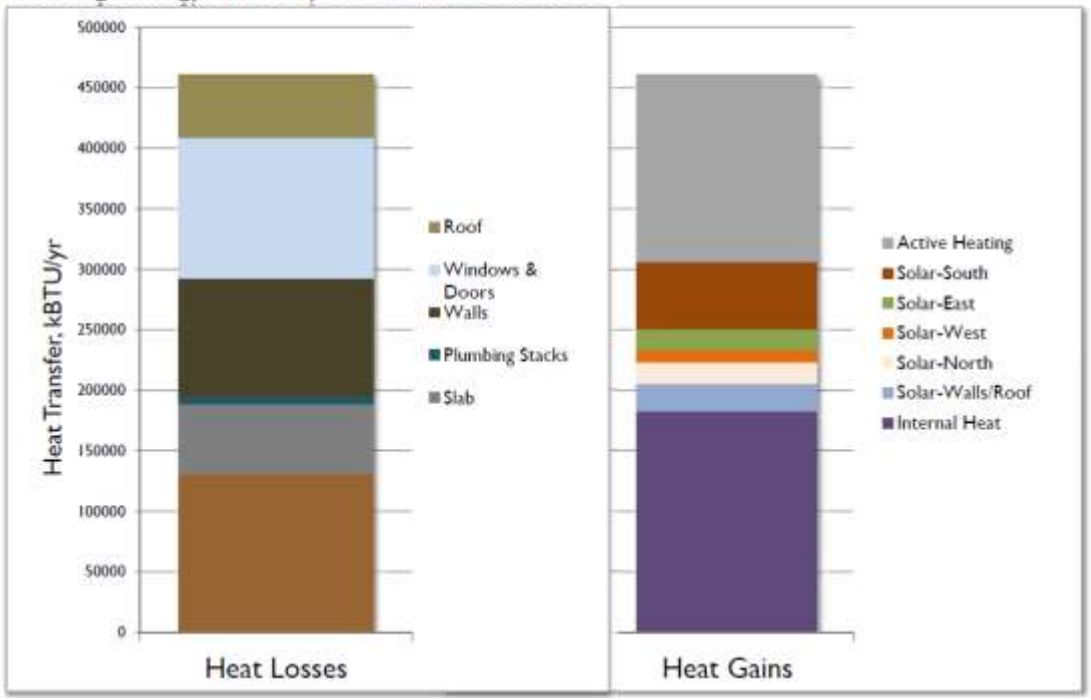
Passivhaus Energy Analysis Update

For Passivhaus Certification Purposes Only

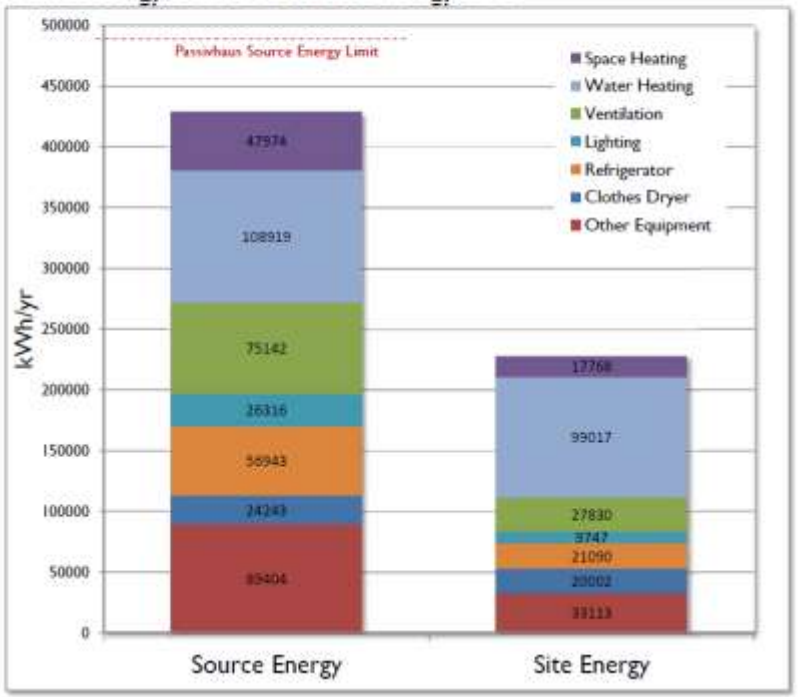
5/1/2012

green hammer
DESIGN | BUILD | ENERGY
1323 SE 6th Avenue, Portland, OR, 503-804-1746

Heating Energy: Envelope Thermal Gain & Loss



Total Energy: Source & Site Energy Use



Energy Modeling

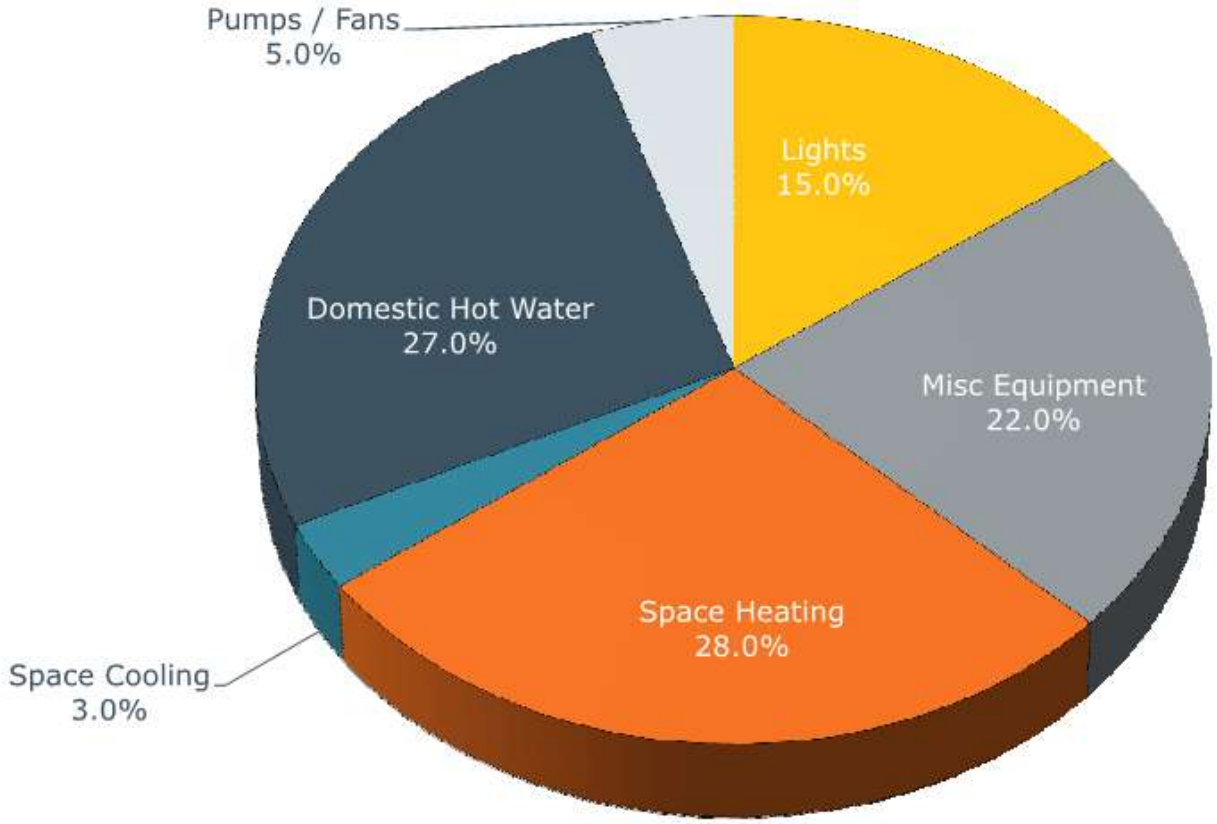
Modeling Methodology

Modeling for Energy Trust Incentives:

- eQUEST model – v3.64
- Baseline HVAC System: PTHP (all electric)
- Bundled Envelope Measures & HVAC System Efficiency
- Infiltration (0.82 ACH_{50} vs. 0.6 ACH_{50})
- Low-flow Plumbing Fixtures

Building Systems

Typical Energy End Uses - Residential

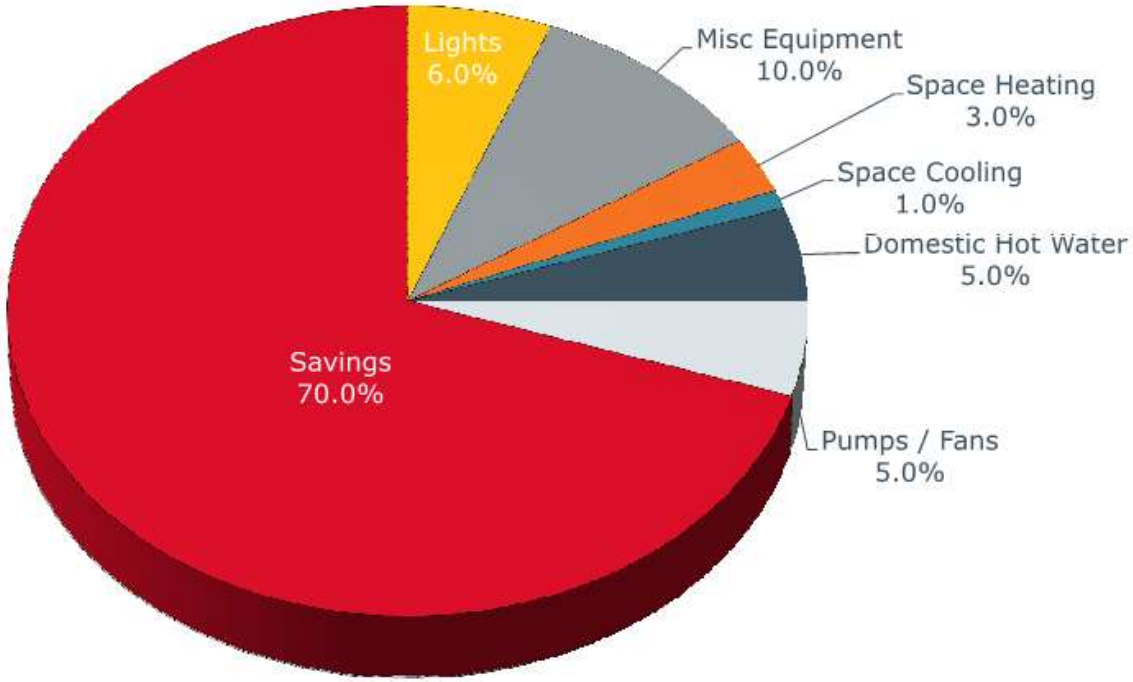


Typical Residential Building: Baseline Energy Use

EUI = 72 kBTU/sf/year

Building Systems

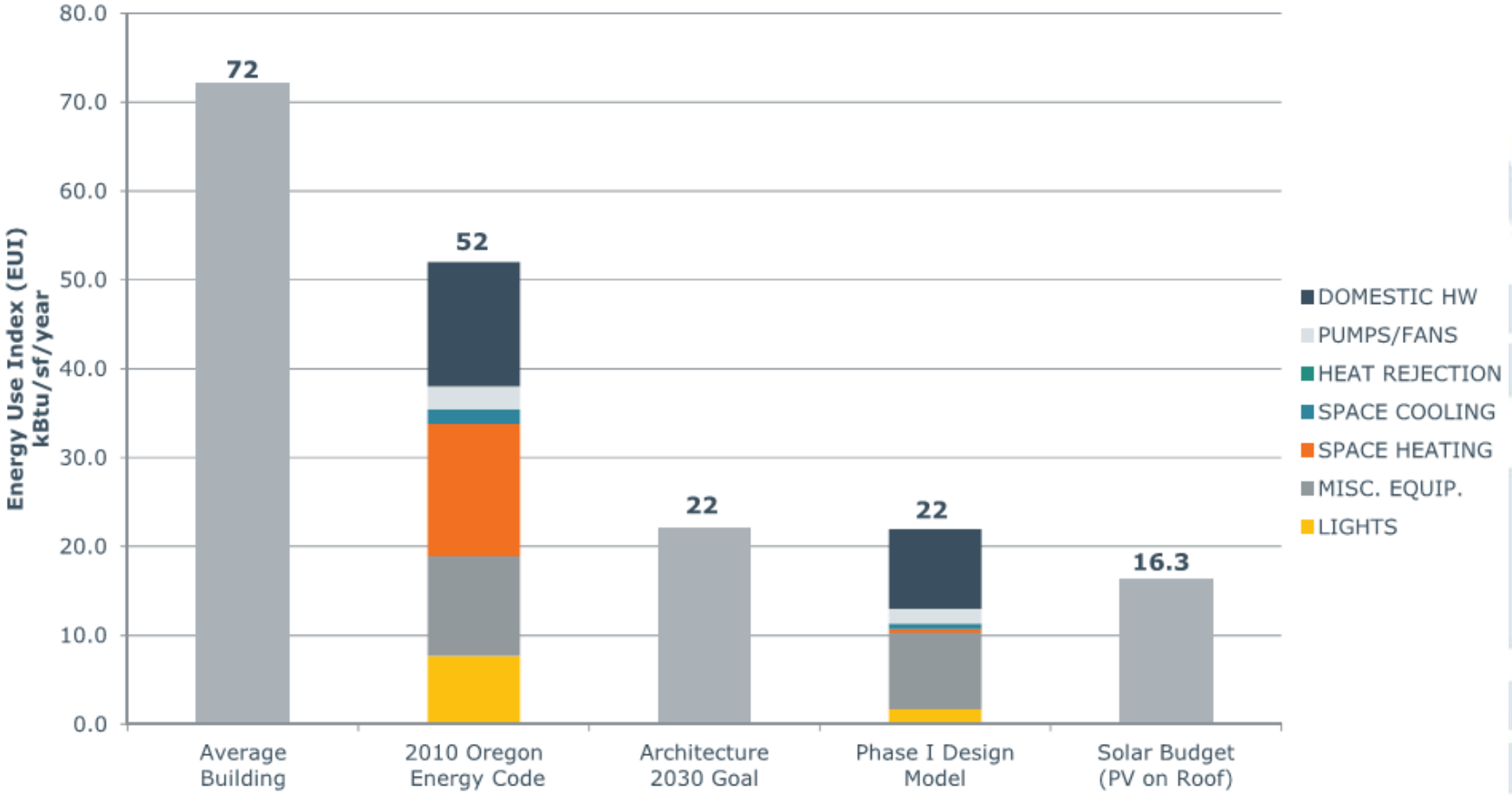
Predicted Energy End Use



Passive House Building
EUI = 20 - 24 kBTU/sf/year

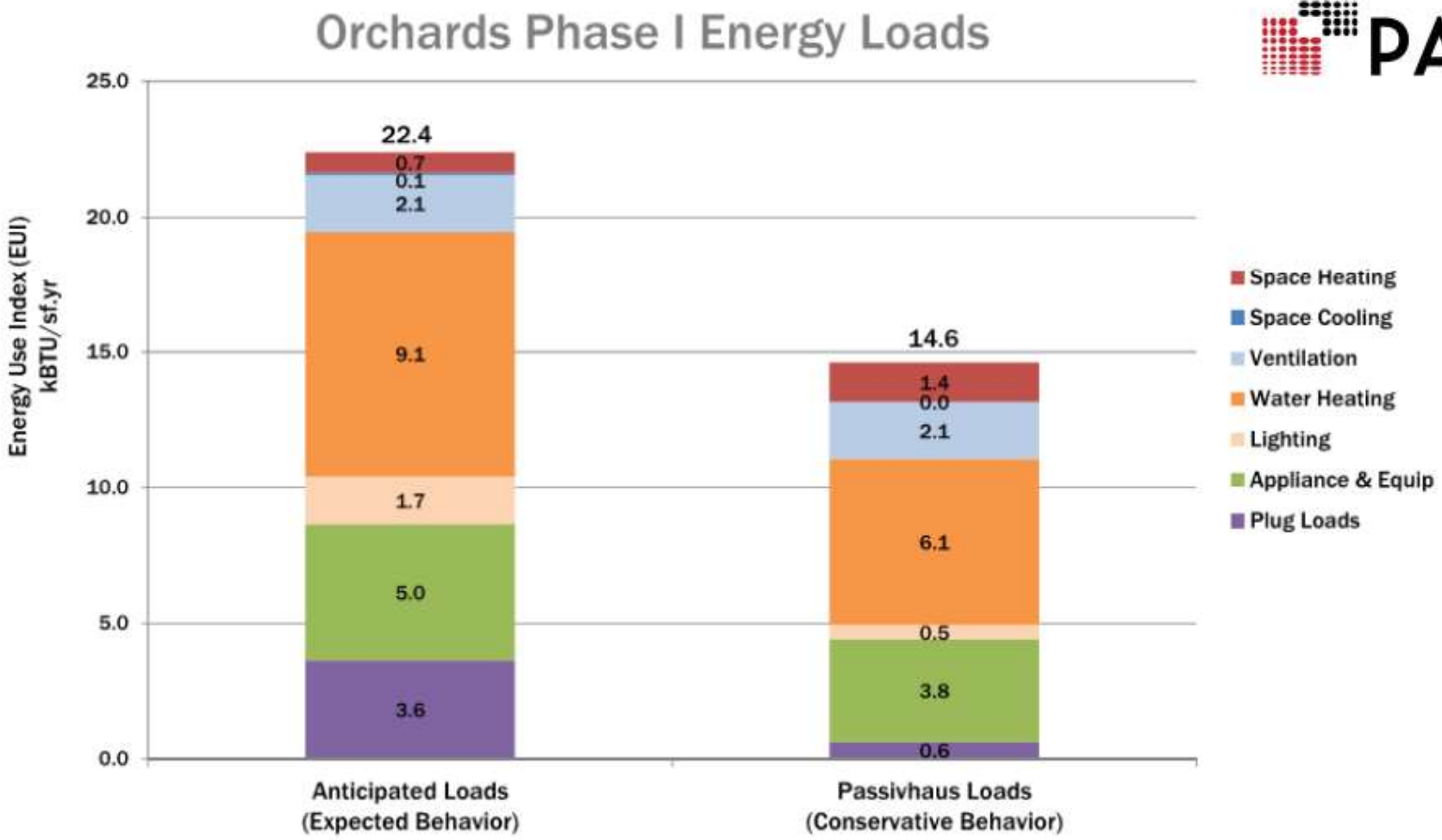
Building Systems

Energy Use Comparison



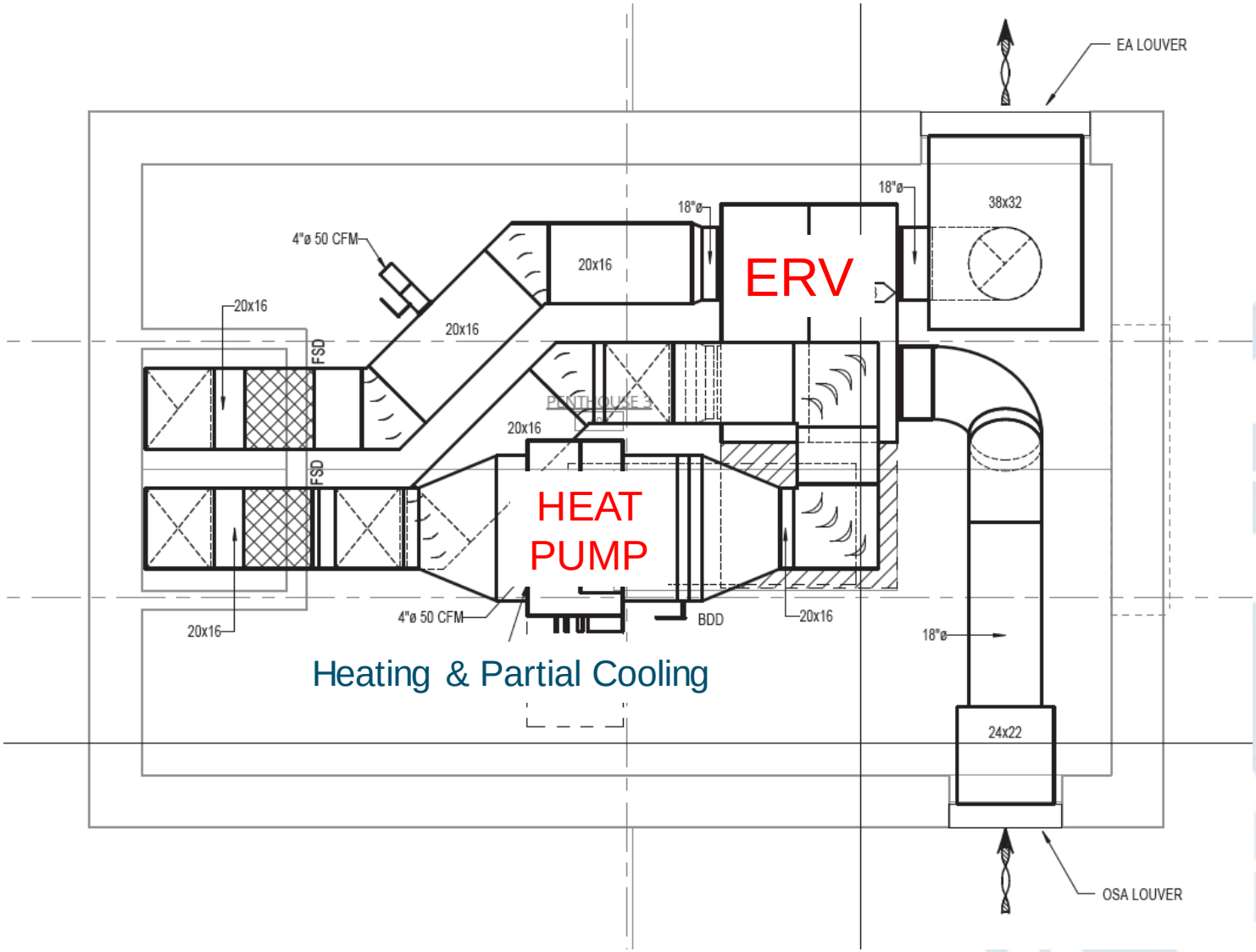
Building Systems

Passive House Energy Analysis



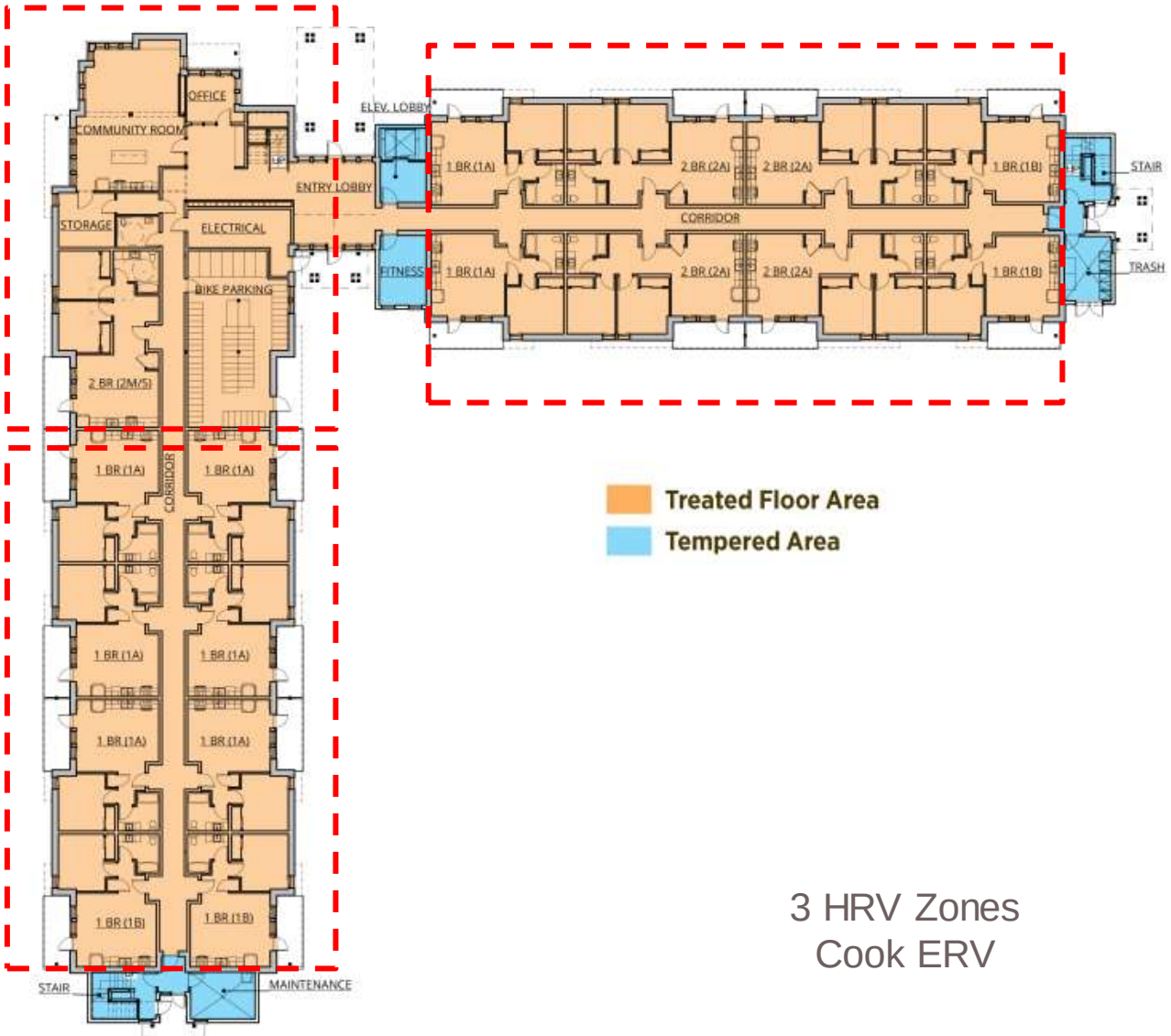
HVAC Design

HVAC Systems



Mechanical Pod

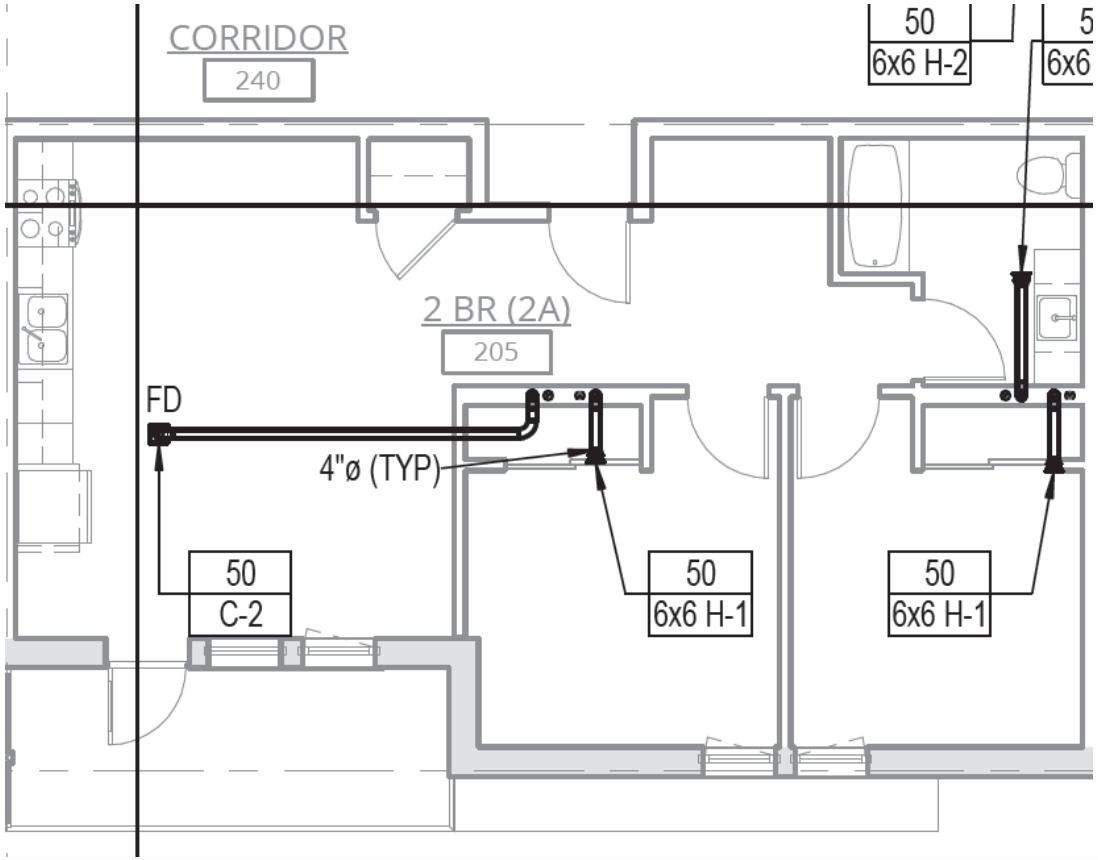
HVAC Design



3 HRV Zones
Cook ERV

HVAC Design

- Continuous 50 cfm supply air per bedroom
- Continuous exhaust in kitchen and bath
- Electric cove heater for user control and backup heat (estimated at 20% of building heating)



Overheating?

- Exterior overhangs at all windows.
- Solar blocking window screens for west facing windows
- Residents need to open windows at night and close during day

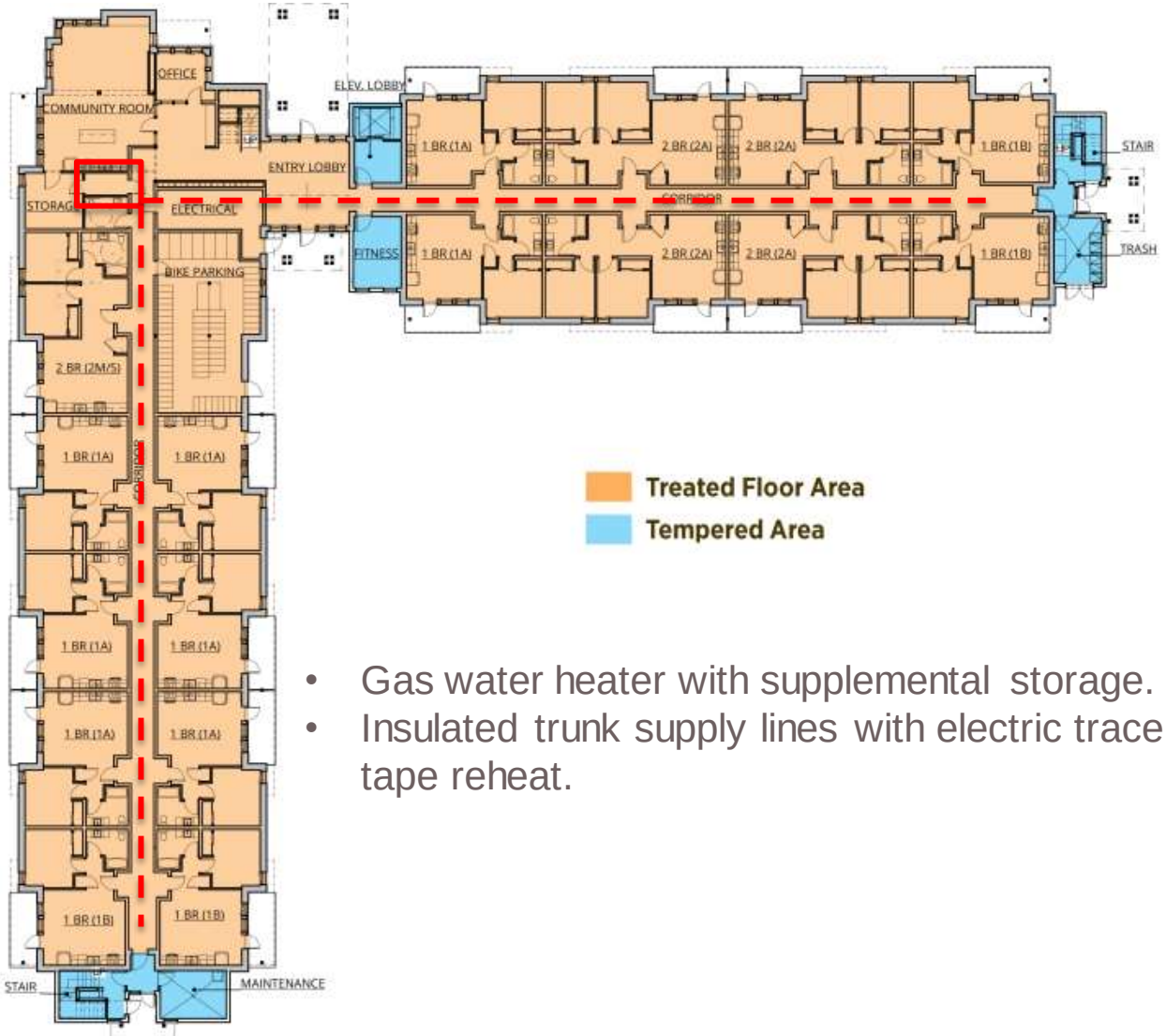
Photo courtesy of Ankrom Moisan Architects and Casey Braunger

Overheating Study

50 cfm supply air per bedroom based on need to provide additional airflow for cooling.

With Active Cooling Automatic bypass of Ventilation Heat-Recovery	Unmet Cooling Demand
4) Cooling Supply 50°F @ 50cfm, Windows Closed	
Low internal heat gains (0.4 W/sf)	4.6%
Medium internal heat gains (0.5 W/sf)	8.6%
High internal heat gains (0.6 W/sf)	13.5%
5) Cooling Supply 50°F @ 100cfm, Windows Closed	
Low internal heat gains (0.4 W/sf)	0%
Medium internal heat gains (0.5 W/sf)	0%
High internal heat gains (0.6 W/sf)	1.5%

Domestic Hot Water



- Gas water heater with supplemental storage.
- Insulated trunk supply lines with electric trace tape reheat.

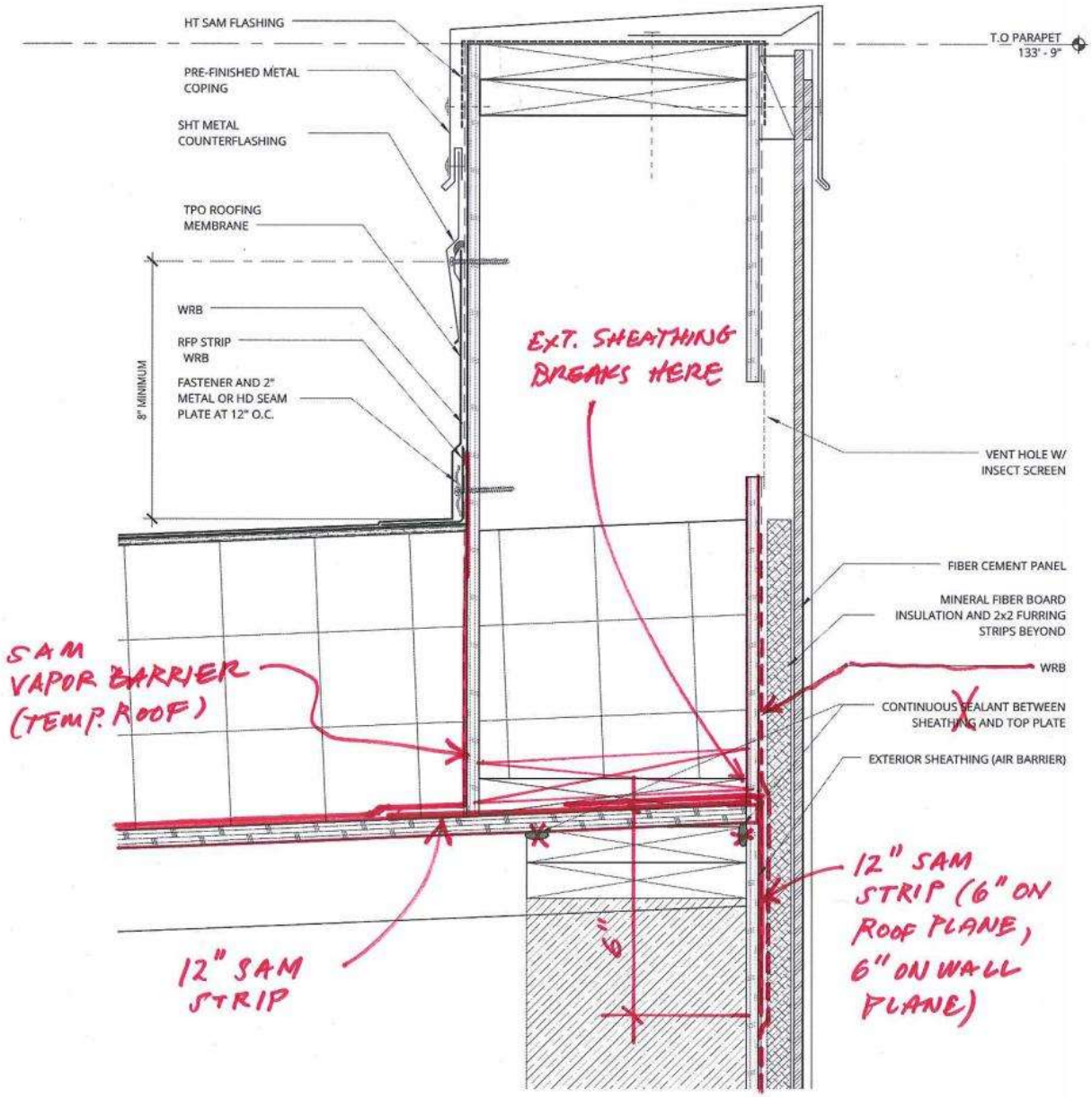
Questions??

BREAK

Building Construction

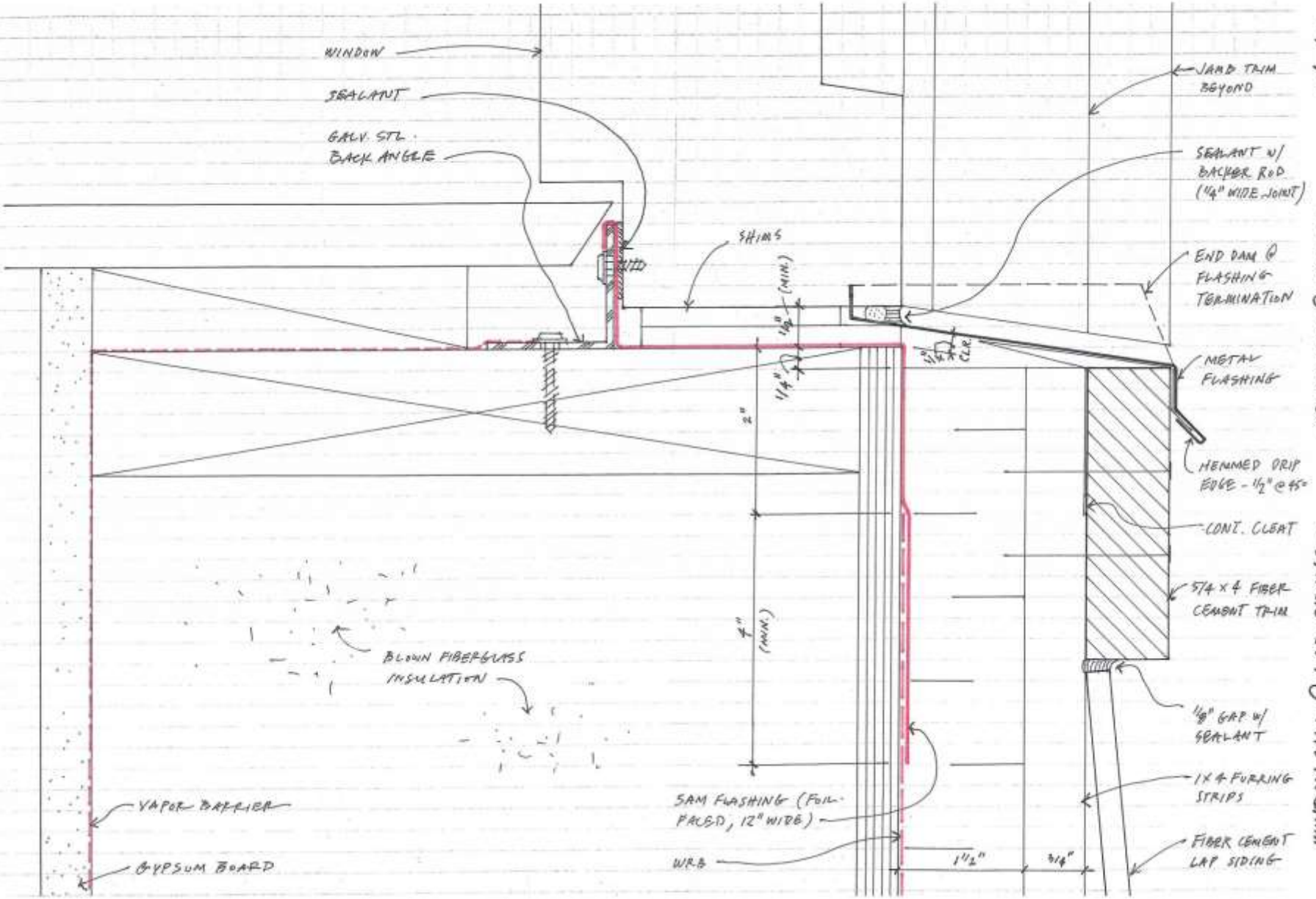
- Integrated Process
  - Construction team involvement
  - Iterative process
  - Cost feedback
  - Constructability feedback
- Coordination of The Work
  - BEC Meeting
  - Submittals / RFIs
  - Detail refinement
  - Mockup
- Construction Process
  - Foundation
  - Walls
  - Roof
  - Cladding
  - HVAC


WALSH
Construction Co.



1 PARAPET AT PASSIVE HOUSE WALL

A4.23 | 3" = 1'-0"

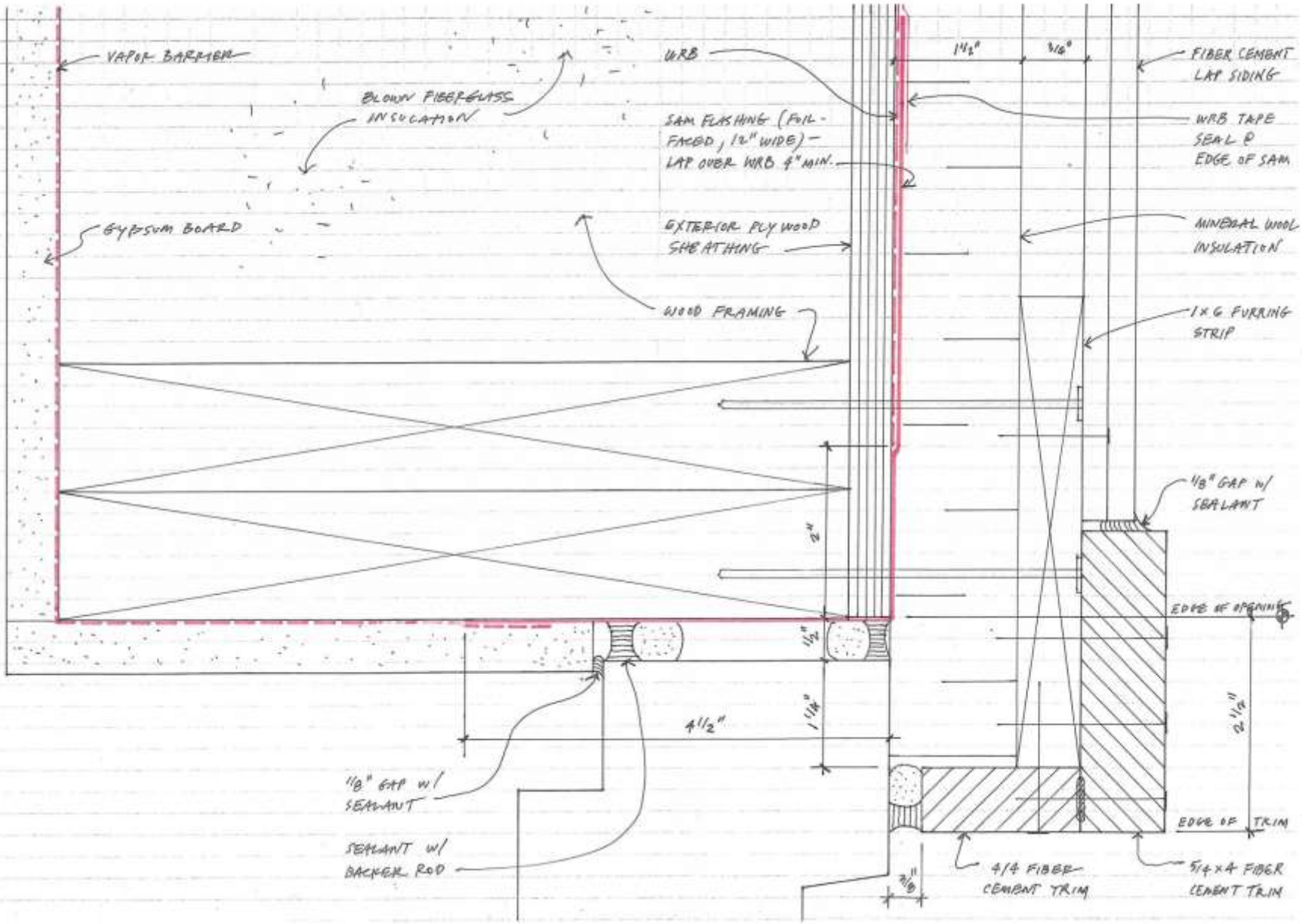


5/12/14 (1)

ORCHARDS @ ORENCO

WINDOW SILL @ LAP SIDING

REF: 19/A7.12



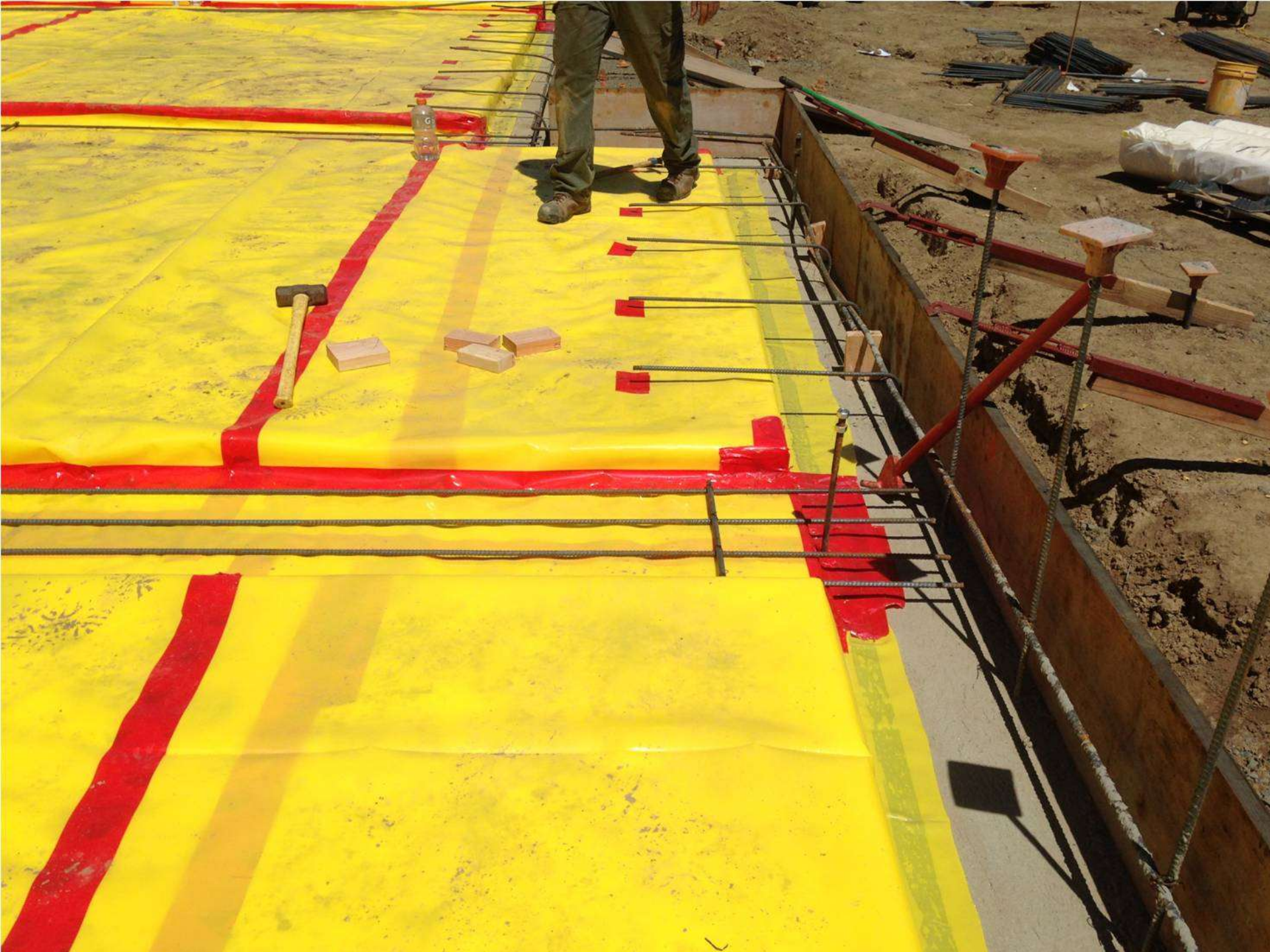
WINDOW JAMB @ LAP SIDING

ORCHARDS @ ORENCO

5/12/14 (2)

REF: 15/A4.12


Protecto Wrap
13.5

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Meets ASTM 2112


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Tyvek


Sto4-Wiglun


Tyvek
COMMERCIALWRAP
Tyvek
COMMERCIALWRAP


WCC
Orchards at Orenco R1A
Location or Type
A2 ew OPP
PFG
28"1/8 x 46"1/8


REST


18"
MIN to
Bottom


COMMERCIALWRAP
COMMERCIAL
Call 1-800-44-TYVEK WWW.CONST
DUPONT The miracle
Protecto Wrap
miracles of s


Tyvek
DUPONT
COMMERCIA
COMMERCIALWRAP
Call 1-800-44-TYVEK WWW.CO


DUPONT
Tyvek
COMMERCIALWRAP


Tyvek
COMMERCIAL WRAP


Tyvek
Honey Bucket

Photo Credit: Bygghouse

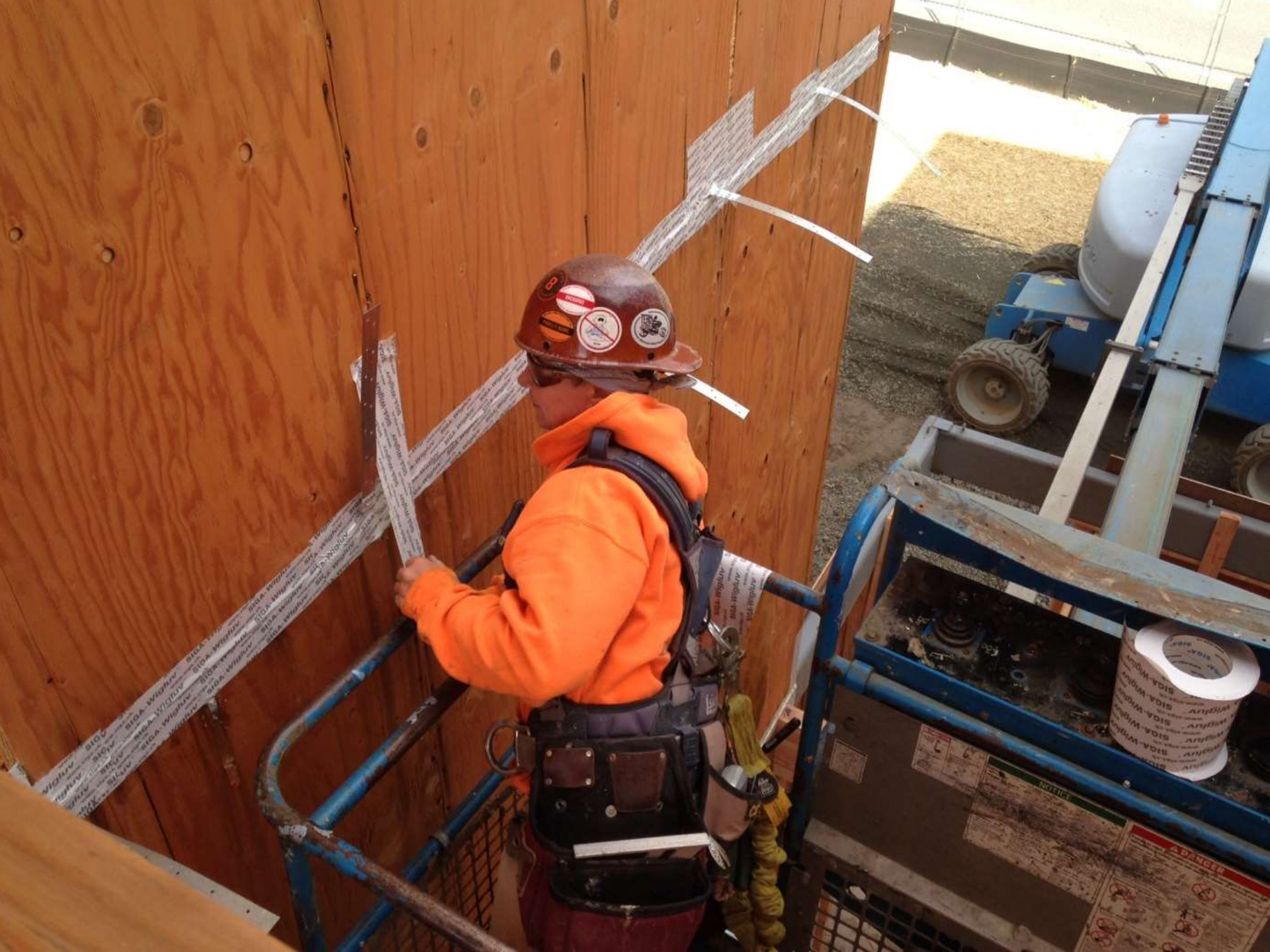

Tyvek
Tyvek
Tyvek
Tyvek

Building Construction

- QA/QC
  - Self-performed work
  - Quality control
  - Sequencing of the work
  - Schedule impacts

- Commissioning
  - Window testing
  - Insulation inspections
  - Duct airtightness
  - Balancing
  - Unit airtightness
  - Building airtightness

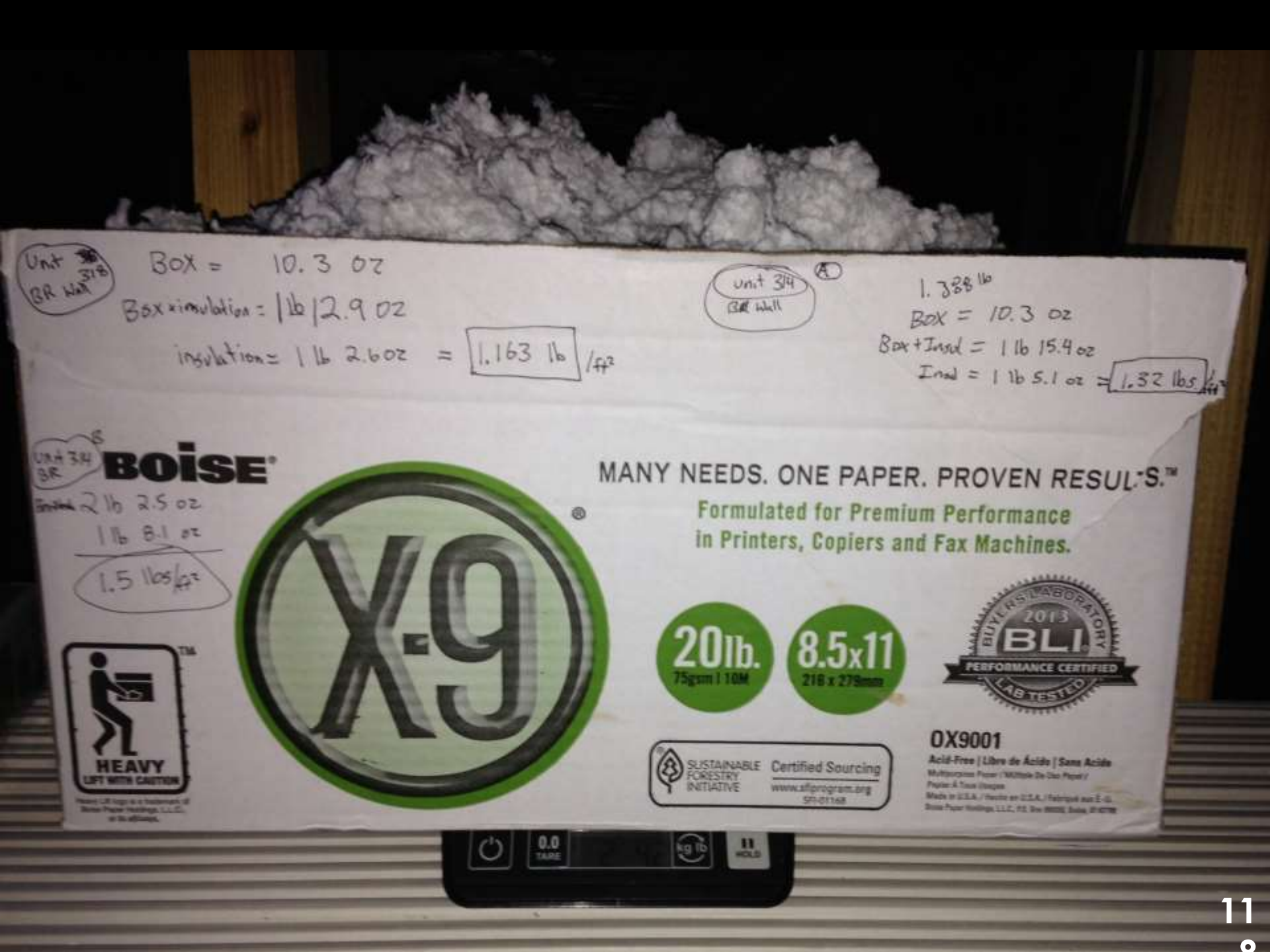

SIGA-
Protecto Wrap
UNION PRIDE
EASTON




CertainTeed
MemBrain
CertainTeed


Panera
upper
cab.


CertainTeed
MEMBRAIN
CertainTeed

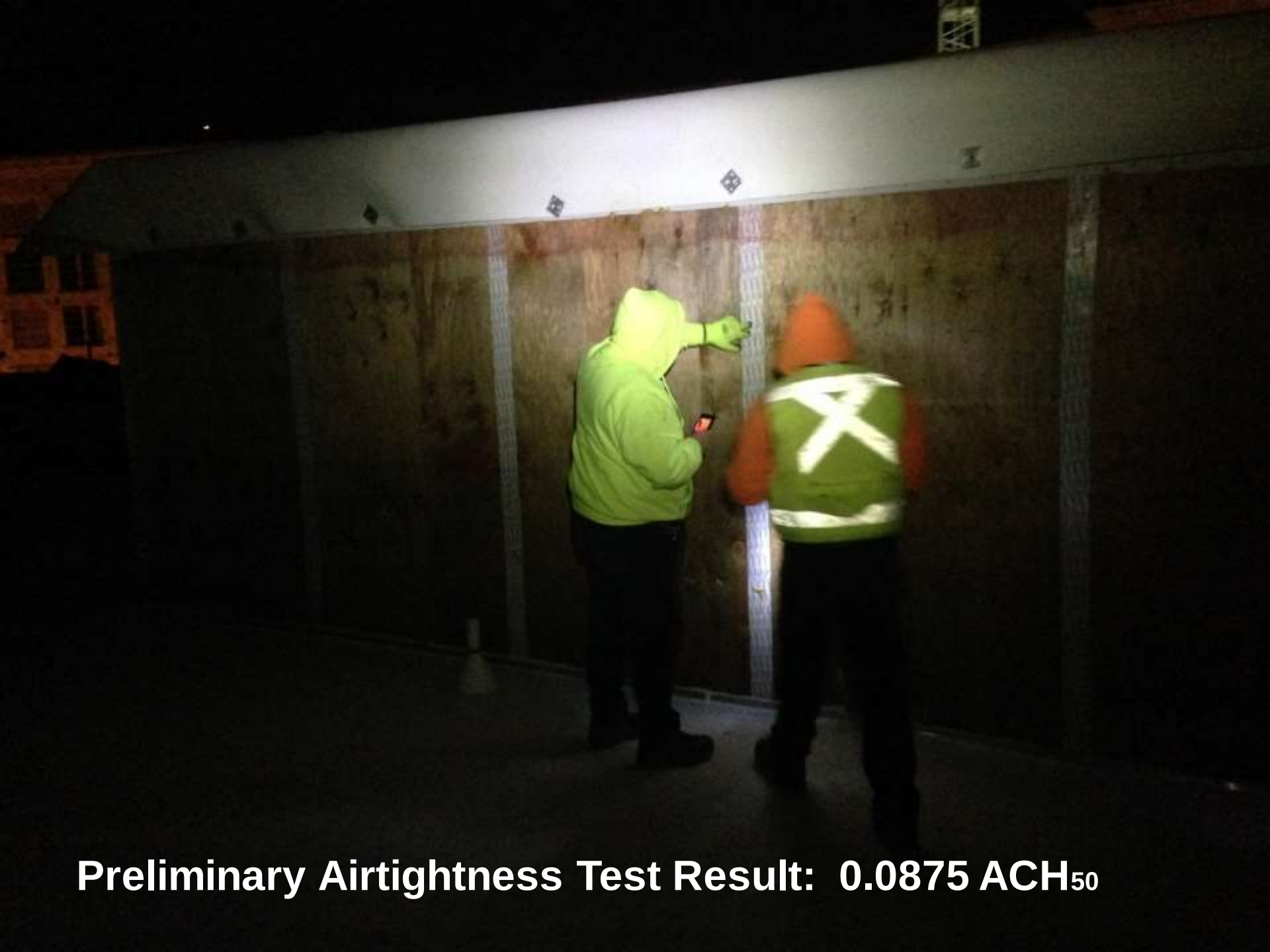

Unit 36
BR Wall 3rd
Box = 10.3 oz
Box+insulation = 1lb 12.9 oz
insulation = 1 lb 2.6oz = 1.163 lb /ft²
Unit 3rd
BR Wall
A
1.388 lb
Box = 10.3 oz
Box+Insul = 1 lb 15.4 oz
Insul = 1 lb 5.1 oz = 1.32 lbs /ft²
Unit 3rd
BR
B
2 lb 2.5 oz
1 lb 8.1 oz
1.5 lbs/ft²
BOISE
MANY NEEDS. ONE PAPER. PROVEN RESULTS.™
Formulated for Premium Performance
in Printers, Copiers and Fax Machines.
X-9
20lb.
75gsm | 10M
8.5x11
216 x 279mm
BUYER'S LABORATORY
2013
BLI
PERFORMANCE CERTIFIED
LAB TESTED
HEAVY
LIFT WITH CAUTION
SUSTAINABLE FORESTRY INITIATIVE
Certified Sourcing
www.sfiprogram.org
OX9001
Acid-Free | Libre de Ácido | Sans Acide
0.0
TARE
kg lb
HOLD


Tyvek
Tyvek
Tyvek


Tyvek
COMMERCIALWRAP
DUPONT
Tyvek
COMMERCIALWRA
100


Do Not Enter


°F
52.0
43.6
FLIR



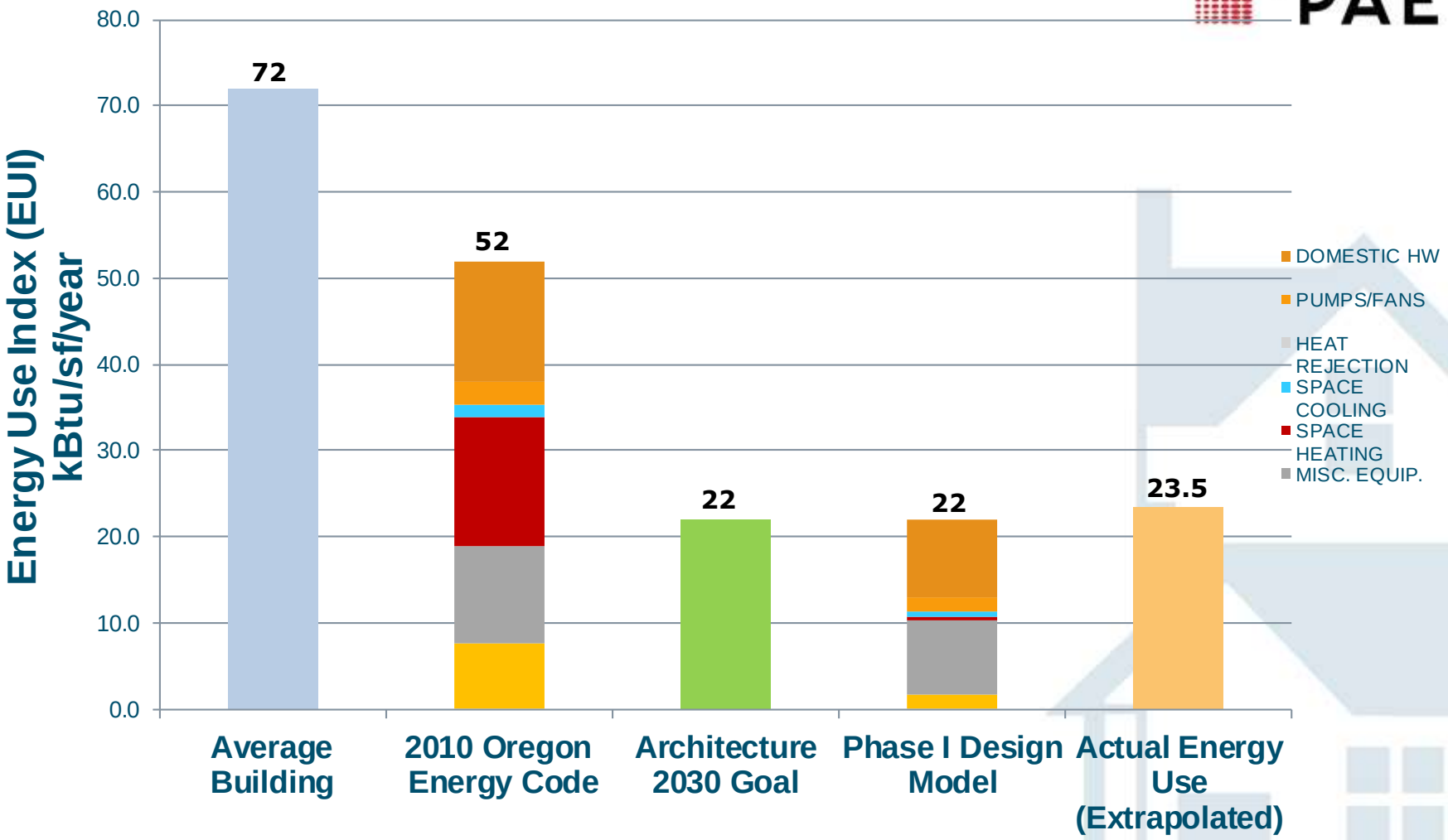
Preliminary Airtightness Test Result: 0.0875 ACH_{50}


EXIT

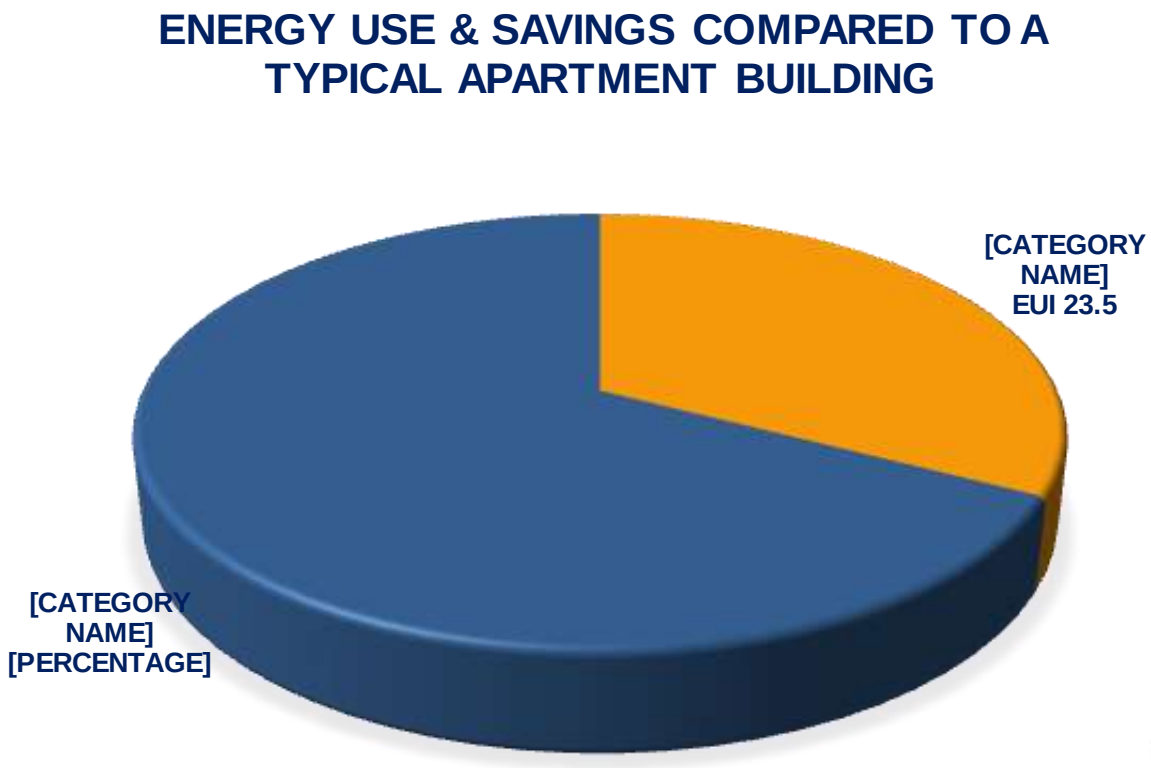
Final Airtightness Test Result: 0.133 ACH_{50}

REACH
Community Development

Actual performance

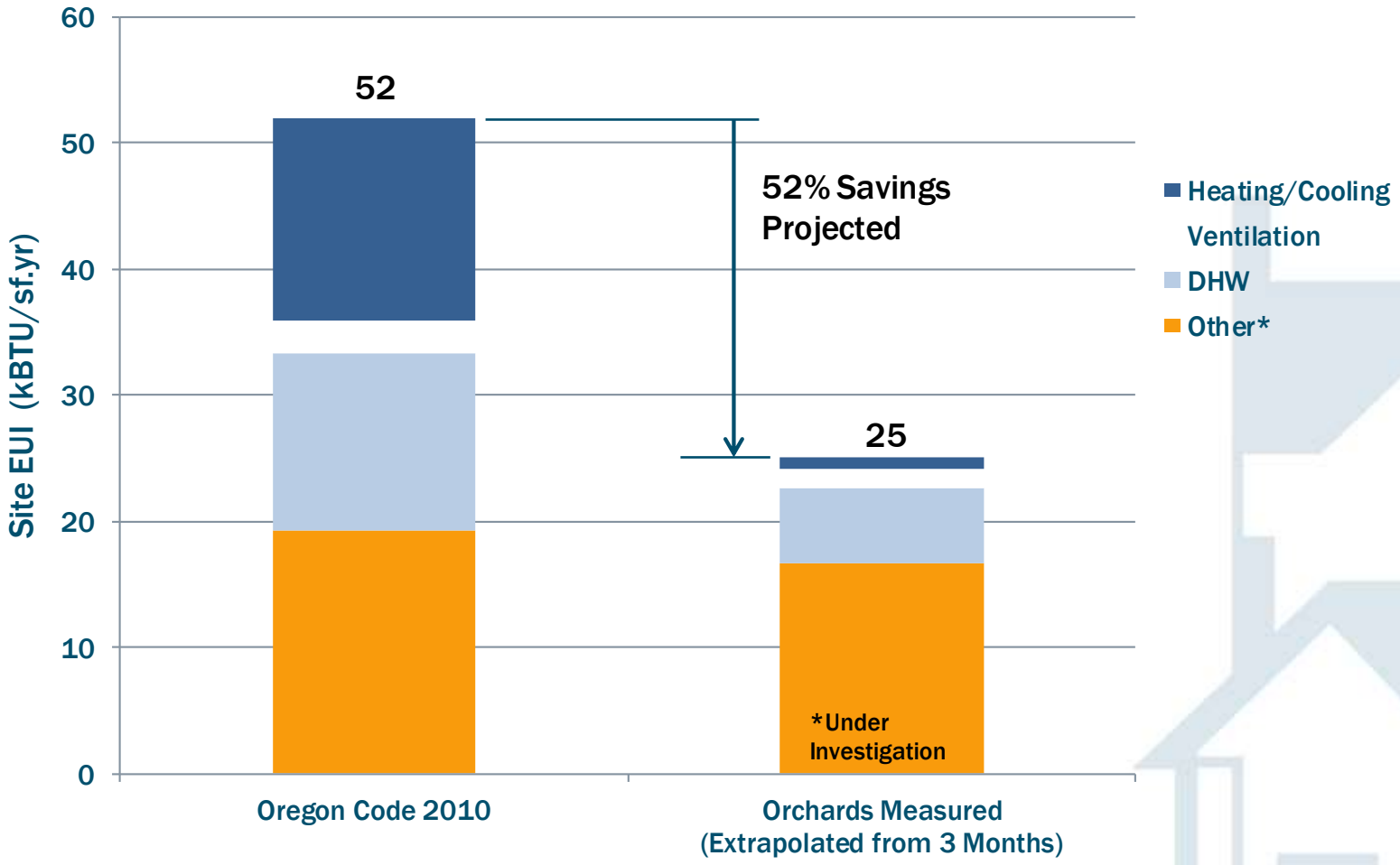


Actual performance

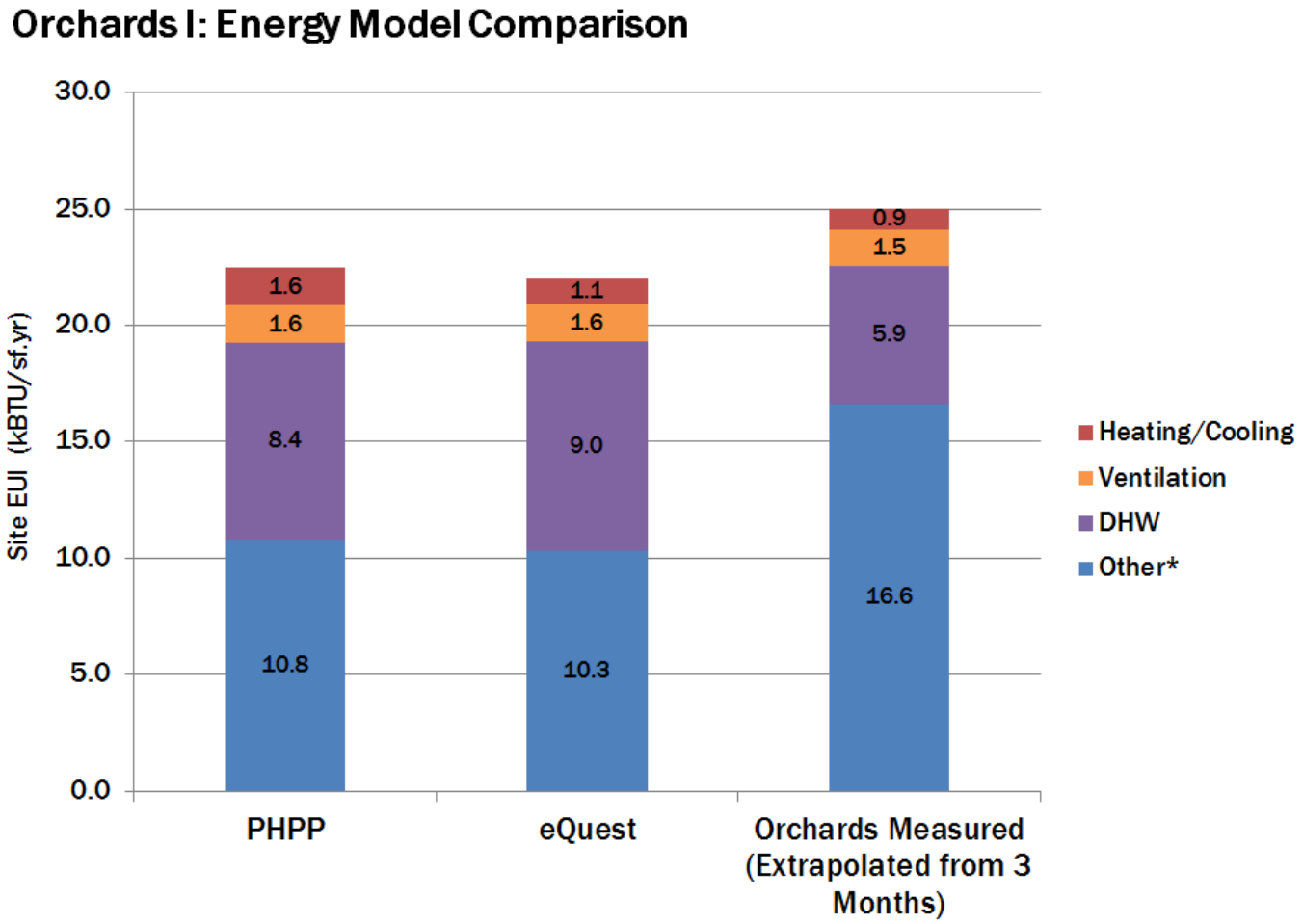


Actual vs Code

Orchards Phase I EUI: Measured vs Code

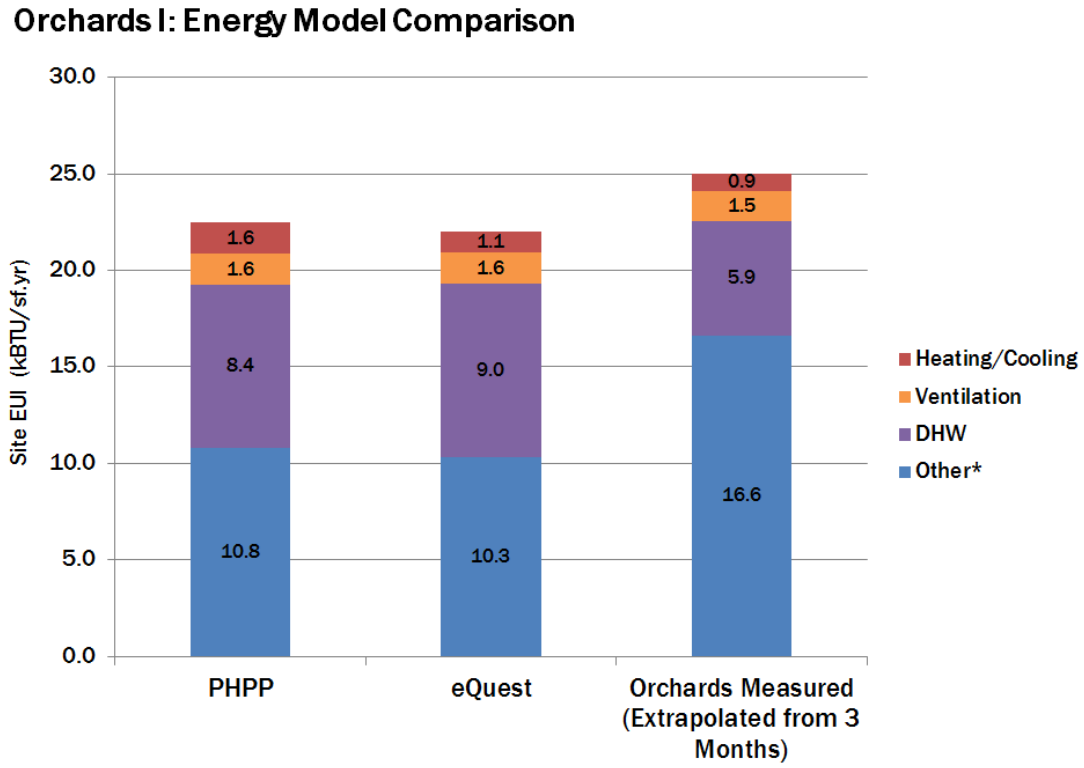


Actual performance vs PHPP & eQuest Model

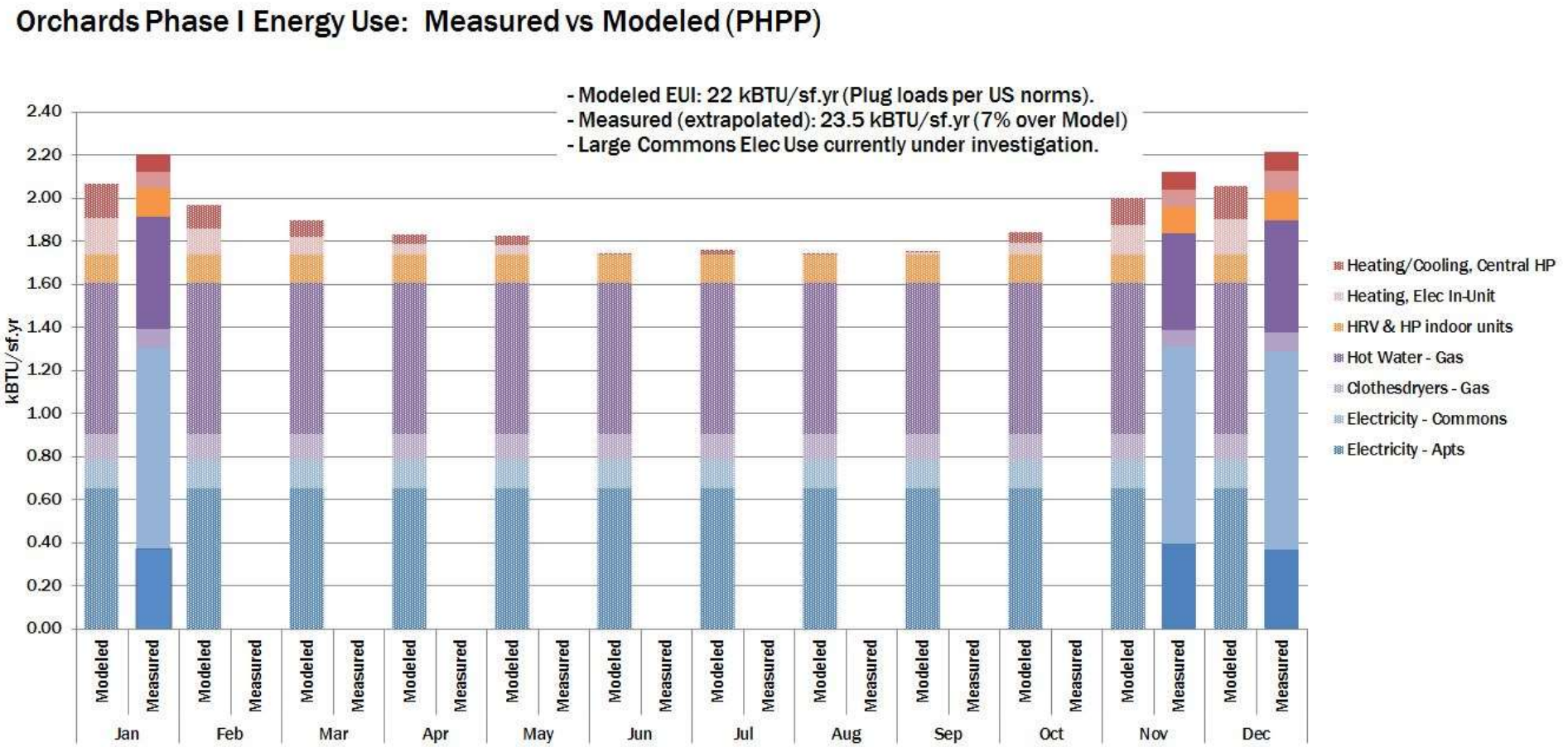


Actual "Other" Usage – Under investigation

- VRF fan coil energy for common areas is being allocated to "other" and not HVAC because of the way the monitoring is set up.
- Ventilation fan energy for laundry, trash, fitness, elevator is being allocated to "other" and not HVAC because of the way the monitoring is set up.
- A fan that is supposed to be on a timer is running continuously
- A freeze protection heater in the non-PH spaces is set at 70 instead of 45
- Elevator usage higher than anticipated
- Other?



Actual performance



Education

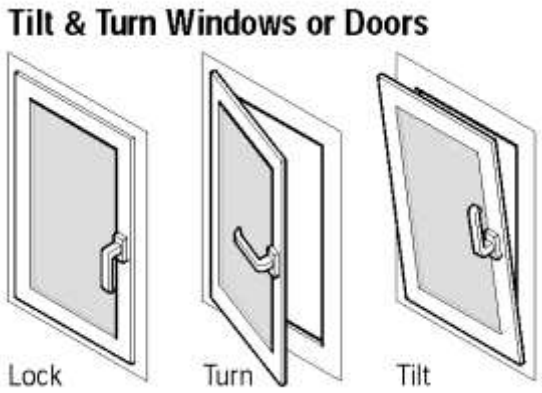
Required more upfront preparation and coordination

Staff – Property Management & Maintenance

- Internal Bucket Meetings
- Owner's Training

Residents

- Lease Up
- Move In
- Ongoing

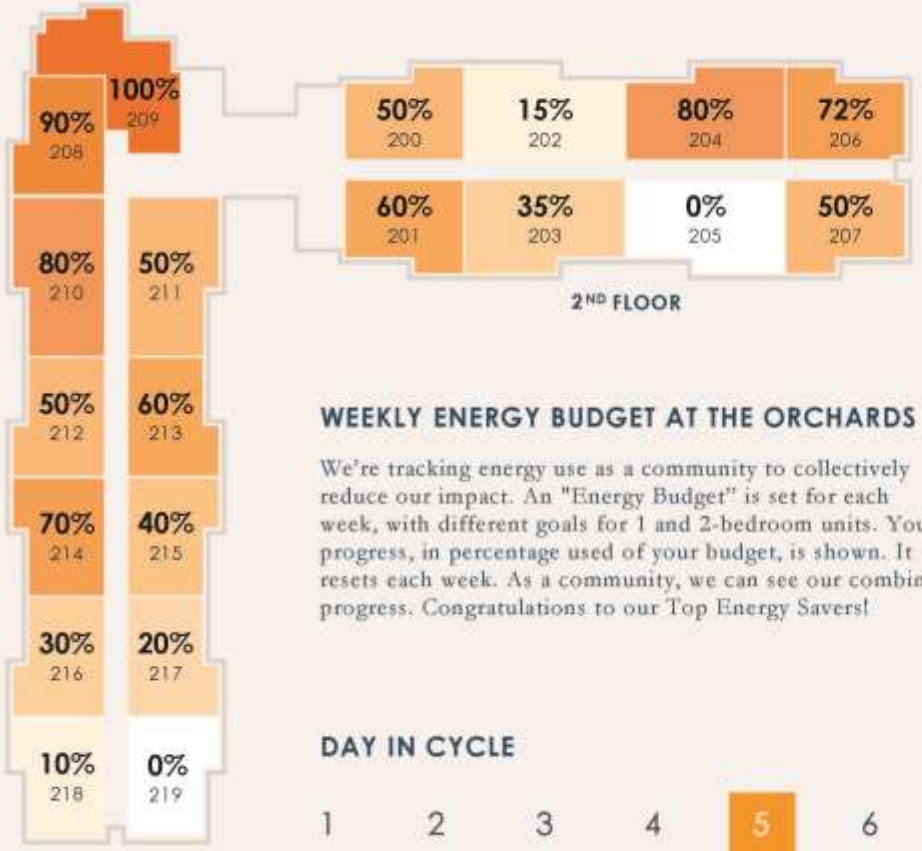


Energy Monitoring

Energy Monitoring

REACH Community Development

The Orchards



WEEKLY ENERGY BUDGET AT THE ORCHARDS

We're tracking energy use as a community to collectively reduce our impact. An "Energy Budget" is set for each week, with different goals for 1 and 2-bedroom units. Your progress, in percentage used of your budget, is shown. It resets each week. As a community, we can see our combined progress. Congratulations to our Top Energy Savers!

DAY IN CYCLE

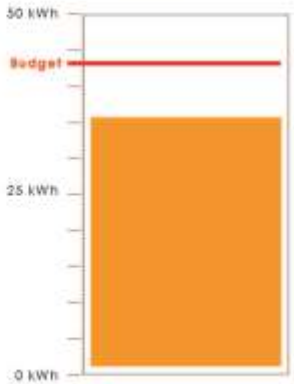
1 2 3 4 **5** 6 7

November 19

Have a great day and stay warm!

- Turn your heat down at night to conserve kwh.
- Room 208, you have a package at the front desk.
- The Office will be closing at 10pm tonight.
- Owner of blue schwinn, please move your bike
- Watch out for ice today! We've salted the side-walks, but it's still dangerous.

Monthly Building Energy Usage



Top Energy Savers

apt. 214

apt. 105

apt. 200

Benefits to residents

- Utility savings – Estimated savings of $30-40/month
- Improved Acoustics – Can't hear the MAX train
- Indoor environmental quality – Continuous fresh air

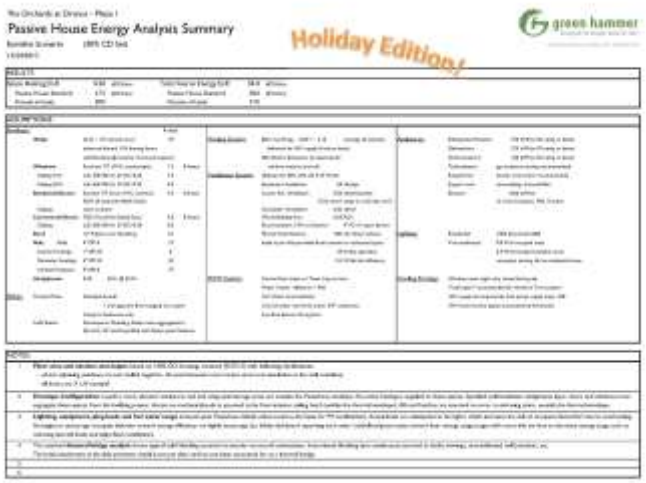
Photo courtesy of Ankrom Moisan Architects and Casey Braunger

Resident Satisfaction

"Every day I find a new reason to love it. It's cool, it's quiet, and I don't even hear the train. During the heat wave, my girlfriend came over to sleep because it was so cool. Yay for German engineering!"

Soft costs - Premium

Incremental Soft Costs		
Design	Amount	Scope
Architecture	37,260	Additional coordination/research
Mechanical	19,600	PAE - Full Design for mechanical system
Energy Modeling	24,000	PAE - Energy Modeling & Incentives
PH consultant	38,720	Green Hammer
Certification	8,000	PHIUS
	21,000	Earth Advantage PHIUS on site review
Total soft costs	**$ 148,580**	


Passive House Energy Analysis Summary

Holiday Edition

Hard Costs - Premium

Description	Amount	
Additional construction duration	$	31,500
Additional supervision/QC	$	25,000
Overexcavation for underslab insulation	$	10,000
2x10 stud wall - additional material cost	$	60,000
Fero clips/brick detailing	$	20,000
Detailing/material for separating interior PH spaces	$	10,000
Siding return detail for overinsulation	$	20,000
Additional flashing details	$	20,000
Roofing insulation	$	50,000
Wall insulation	$	53,907
Slab on grade insulation	$	55,711
Windows and Deck Doors	$	176,217
Commercial doors, including interior PH doors	$	38,443
HVAC	$	-
Infiltration costs	$	83,886
Hot water heater	$	2,000
Low flow fixtures	$	3,480
Temp maintenance system	$	15,000
Lighting	$	-
Appliances	$	6,256
Energy monitoring system	$	87,000
Elevator	$	-
Siding/rain screen	$	20,000
Blocking, Hold offs, SAM	$	25,000
Air Testing	$	10,000
Other misc. costs	$	50,000
Subtotal	$	873,400
Markup	$	37,120
Total hard costs	$	910,520

Financing

Orchards at Orenco Phase I

Uses

Incremental Soft Costs	$ 148,580	
Incremental Hard Costs	$ 910,520	
Total incremental Cost	$ 1,059,100	
Premium over "typical Orenco"		11.0%

Sources		
REACH Equity	$ 300,000	
Meyer Memorial Trust grant	$ 500,000	
Neighborworks grant	$ 260,000	
OHCS Weatherization	$ 100,000	
Energy Trust of Oregon	$ 65,000	
Enterprise charrette grant	$ 4,000	
Total additional Sources	**$ 1,229,000**	

Lessons Learned
Development Process

- The importance of establishing the vision, including a specific goal, early
- Importance of having commitment from the decision makers
- Selecting the right team at all levels of the project
- Integrative and iterative design process
- Early construction team involvement
- Learning from other projects (Stellar, Kiln) and sharing the learning with others

Lessons Learned
Design

- Building orientation – not ideal for solar due to urban design considerations that drive building form
- Window to wall ratio – Initial 26% glazing, final 18%
- Unit plan orientation and glazing ratio doesn't take advantage of long exterior wall
- Design review required building articulation and materials that work against PH
- Shallow floorplates might have been avoided by better integration of massing studies and energy performance feedback

Lessons Learned
Construction

- Integrated teamwork pays off --- fewer issues during construction
- Managing the bid process requires a lot of diligence --- ensuring scope coverage…
- Coordination process with subs --- GC must be extremely proactive

Lessons Learned
Construction

- Detail for air barrier continuity (process → tracing the barriers)
- Construction team must collaborate to help finalize the design…
- Schedule impacts…
- What we learned from preliminary blower door test…
- Design adjustments during construction phase (after prelim blower door test)
- Takeaways from final blower door test, and additional iterations…

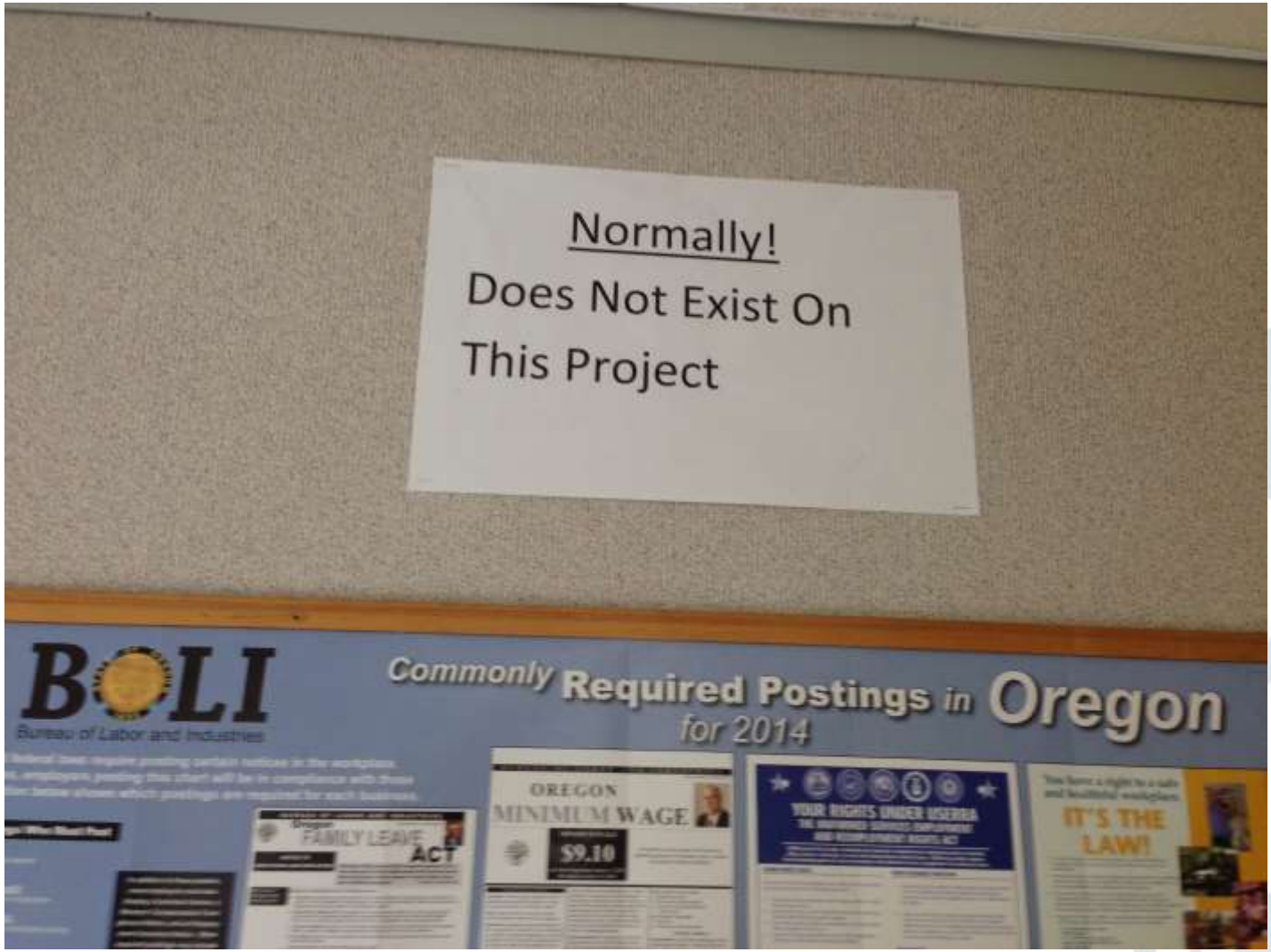
Lessons Learned:
This is really hard, have a sense of humor

Meow, meow,
separated at birth?

You decide.

Photo courtesy of Laura Recko

Lessons Learned



QUESTIONS?

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