ORCHARDS AT ORENCO

The largest affordable multifamily Passive House project in the United States

Ankrom Moisan

Architecture / Interiors / Urban Design / Branding

Project Team

REACH Community Development — *Owner/Developer*

Housing Development Center — *Owners Representative*

Ankrom Moisan — *Architect of record*

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

WALSH CONSTRUCTION CO. — *General Contractor*

PAE — *Mechanical Engineer*

STONEWOOD DESIGN — *Structural Engineer*

PLANNING & ENGINEERING
MGH
104 West 9th Street
Suite 207
Vancouver, WA 98660
www.mghassociates.com
PEOPLE MAKING PLACES®
P: 360.750.0399 (WA)
P: 503.417.8639 (OR)
F: 360.750.0433
— *Civil Engineer*

WALKER | MACY — *Landscape Architect*

william wilson architects pc
1010 SW ELEVENTH AVENUE, PORTLAND, OREGON 97205
(503) 223-6693 Fax: (503) 274-0052 www.wwarchitects.com
— *Design Architect*

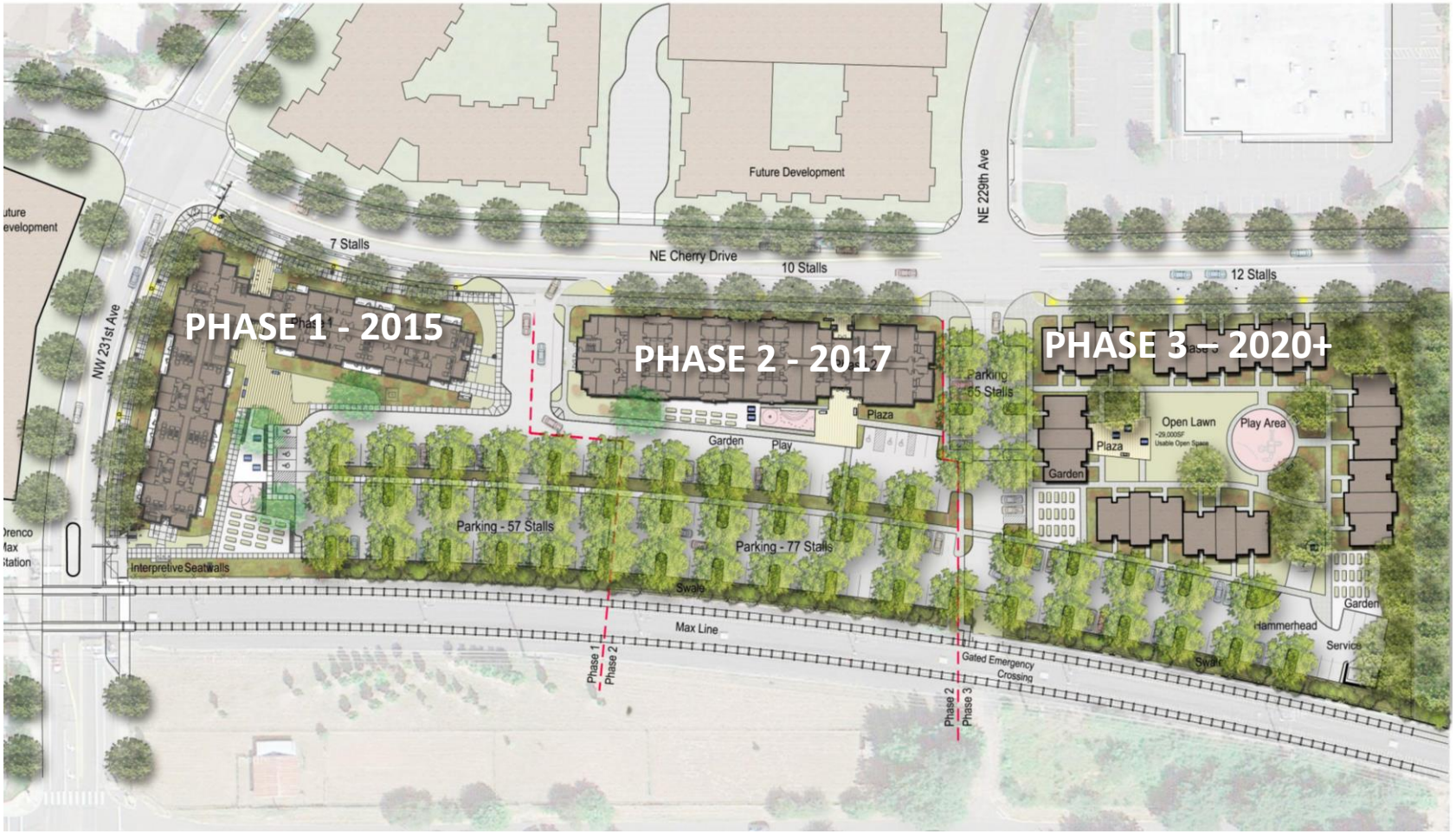
Owner's Motivation and Goals

REACH Community Development

Owner/Developer

- REACH has developed and managed affordable housing since 1982
- Today their portfolio has apartments for 1,852 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 Overview

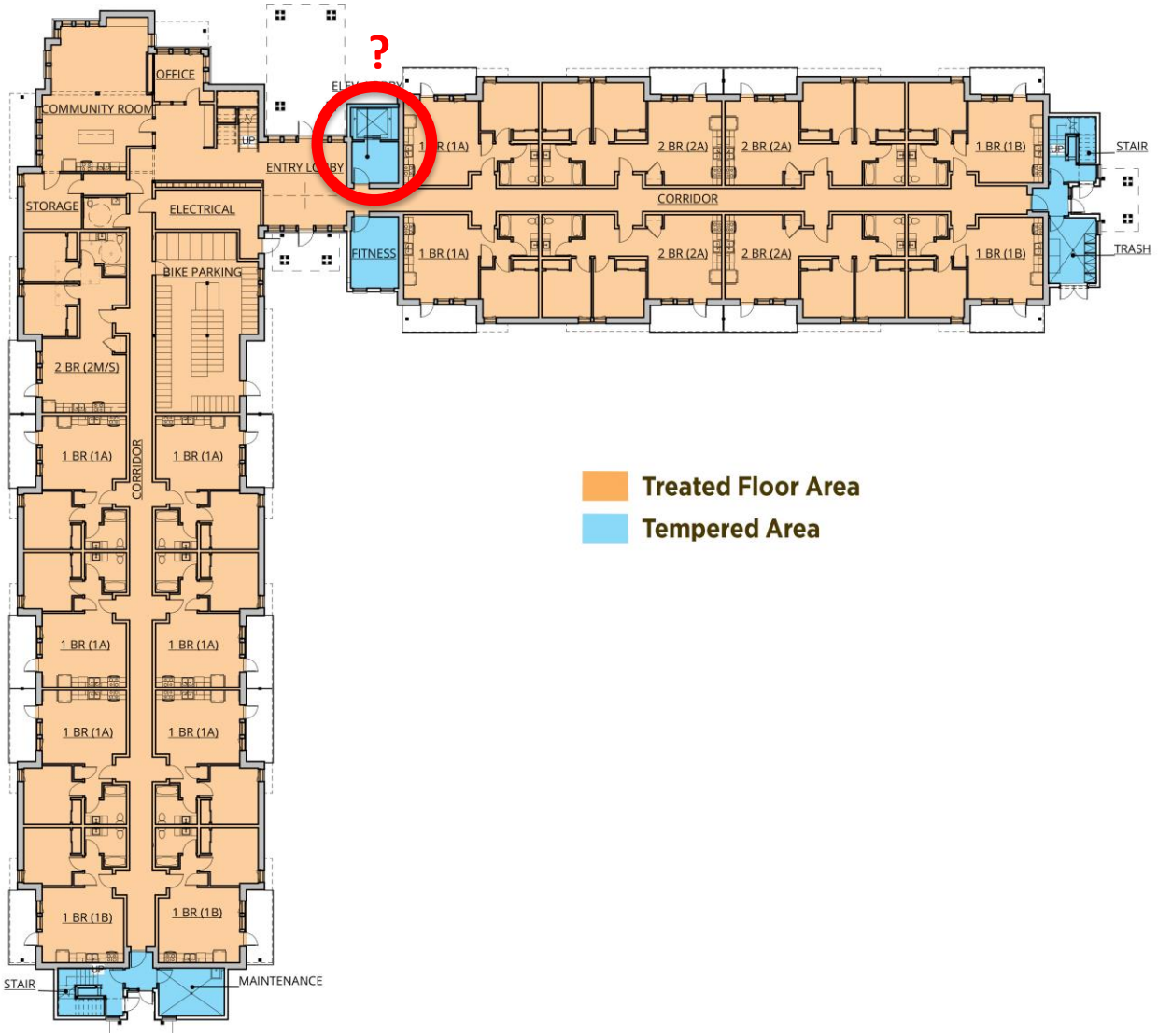


Building Design

Building Design

VIEW FROM NORTHWEST CORNER
Rendering by William Wilson Architects

Building Design



Integrated Team / Integrated Approach

All core team members present on project from very beginning…

- Owner
- Design team
- Construction team

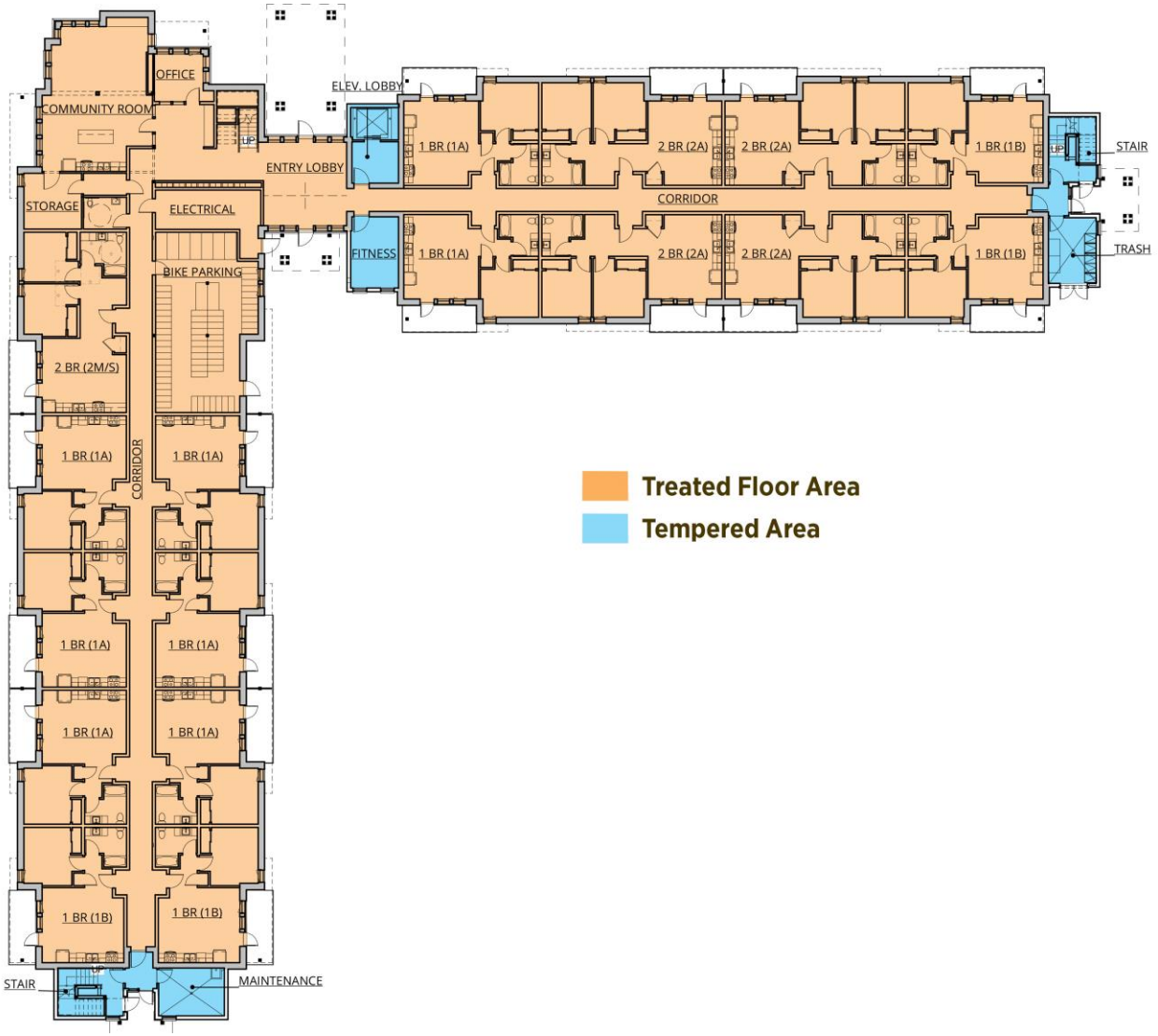
Design Charrette

- 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

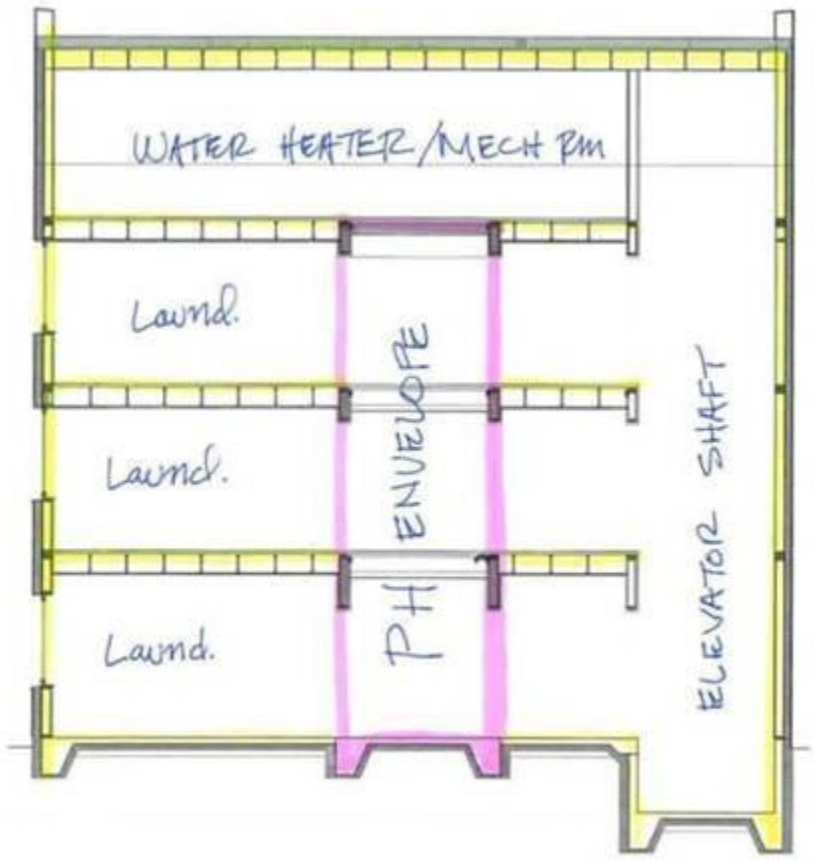
Developing the Design

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

Integrated Team / Integrated Approach

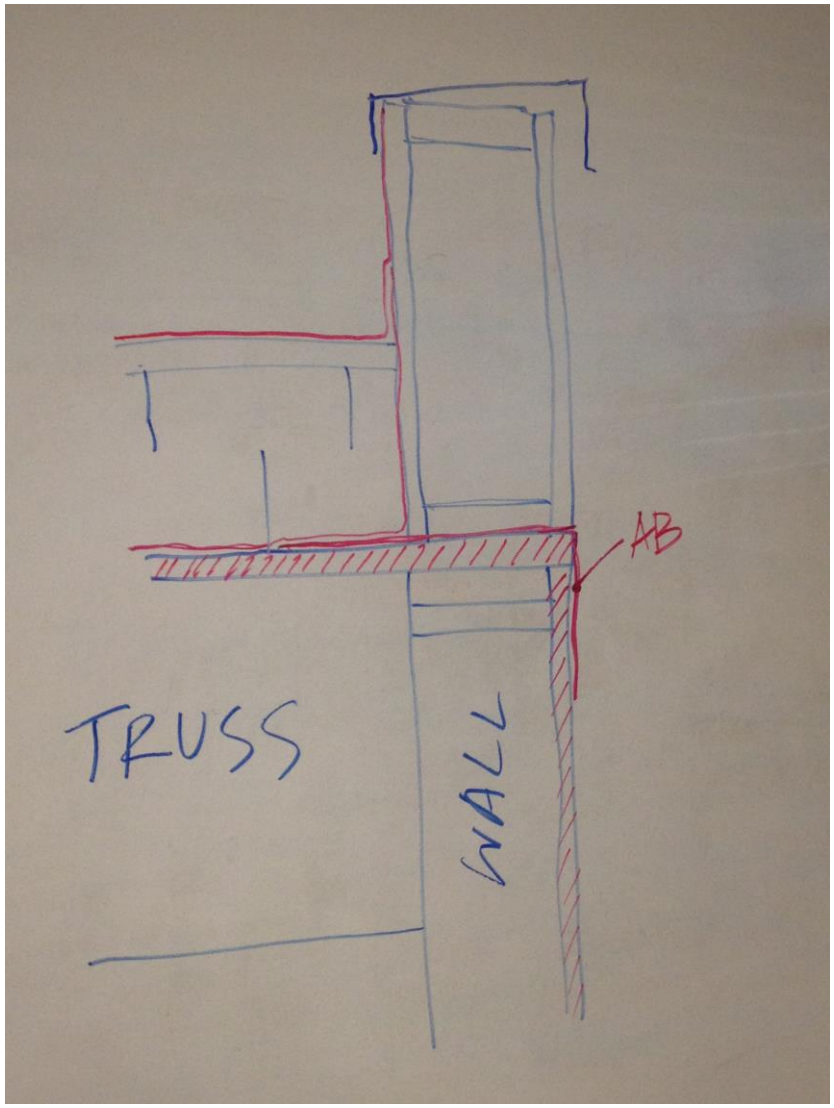


Integrated Team / Integrated Approach



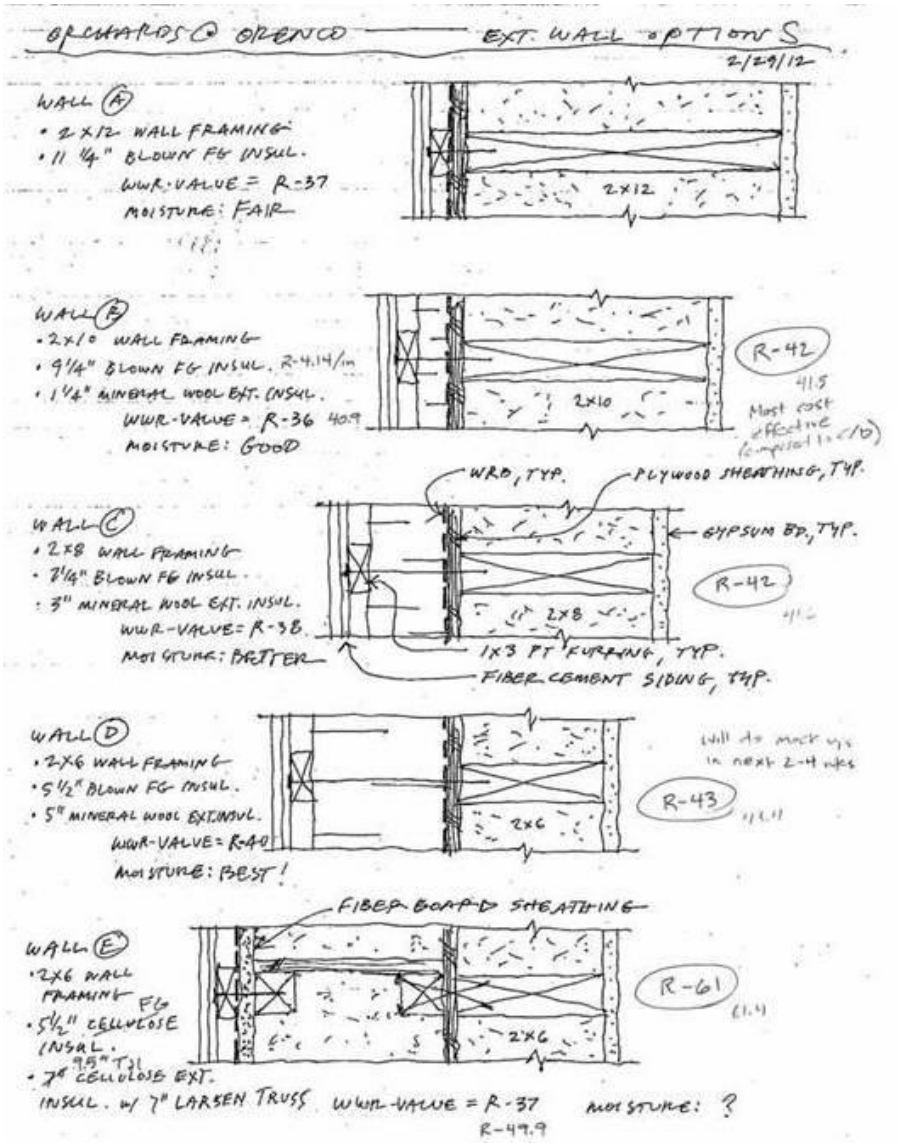
SCHEMATIC SECTION

Integrated Team / Integrated Approach



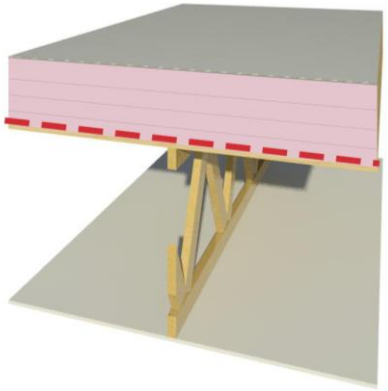
SCHEMATIC DETAILS

Integrated Team / Integrated Approach



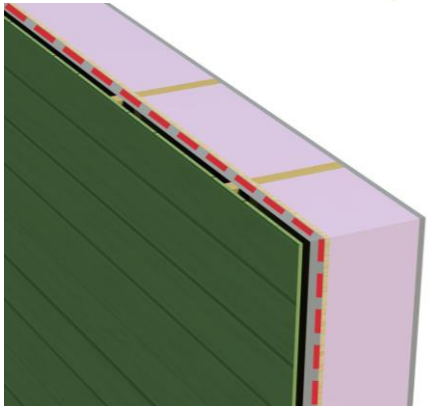
EXTERIOR WALL OPTIONS

Envelope Design



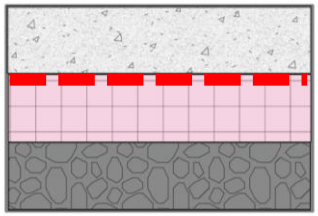
Typical Roof Assembly: R-81

- 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

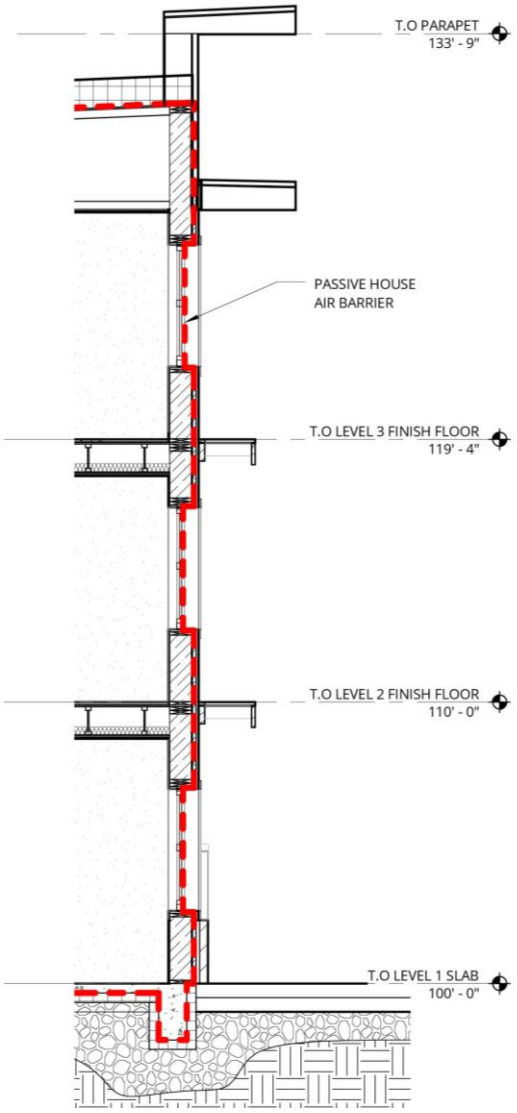
- Fiber cement siding w/ furring @ 24” o.c.
- 1-1/2” mineral fiber board insulation
- Building wrap weather barrier
- ½” Plywood w/ AB Tape at Seams (Air Barrier)
- 2x10 framing with blown-in fiberglass insulation
- Vapor barrier
- 5/8” Gypsum Wall Board



Typical Slab Assembly: R-19

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

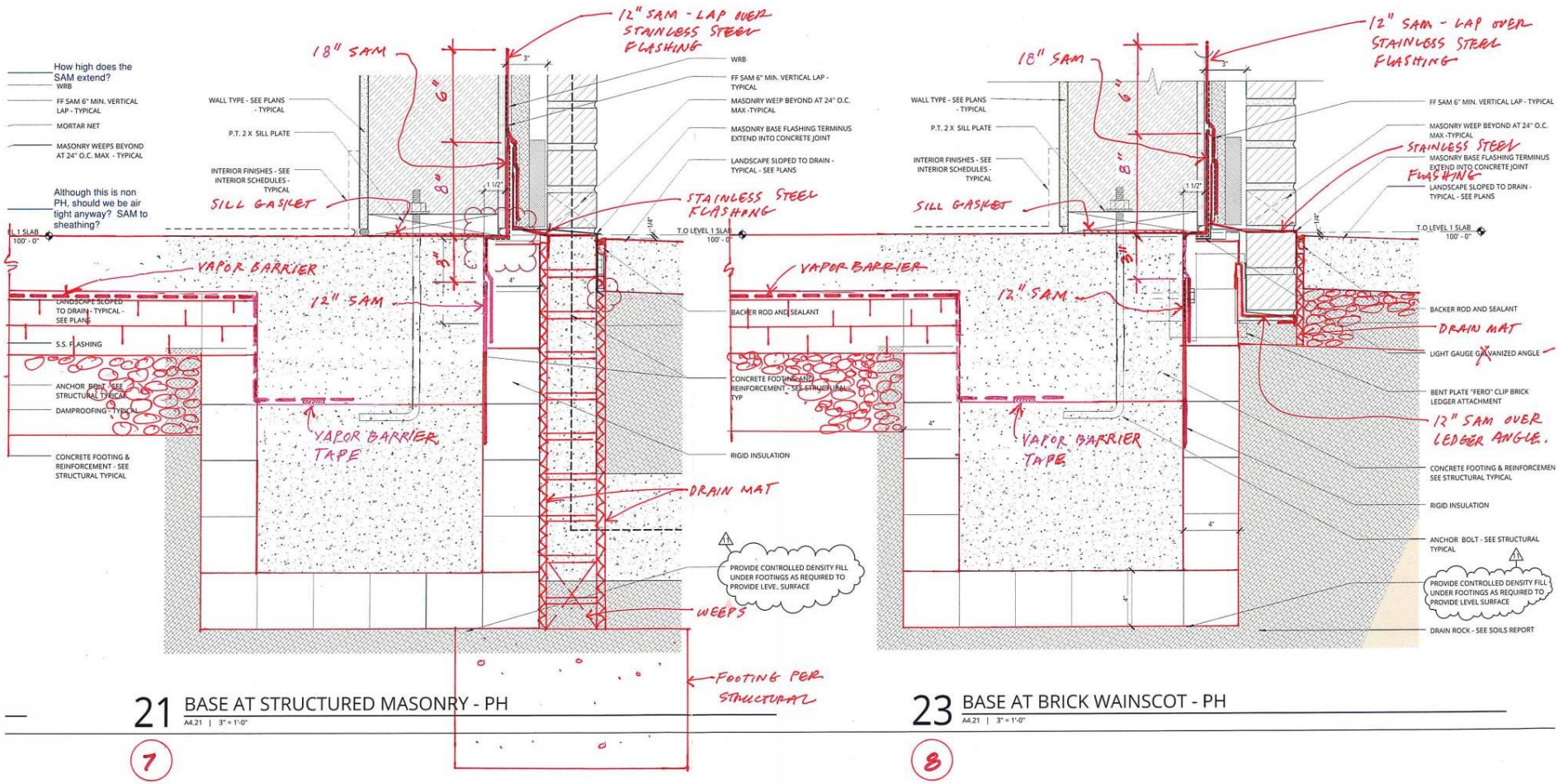
Envelope Design



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.

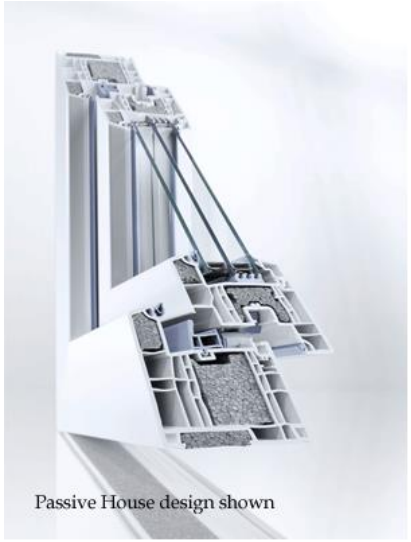

Protecto Wrap
SIGA-Wigluv

Component Selection

Component Selection - Windows

WINDOW WISH LIST

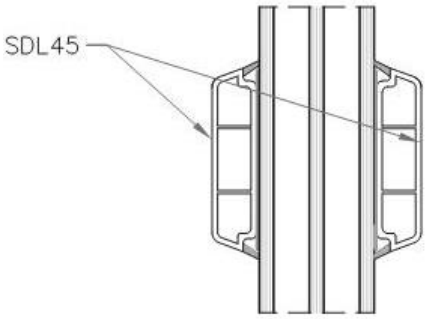
- Thermal Performance
- Airtight
- Watertight
- Affordable
- Locally Sourced



Euroline 4700 Series
U-0.16 BTU/hr.ft²°F

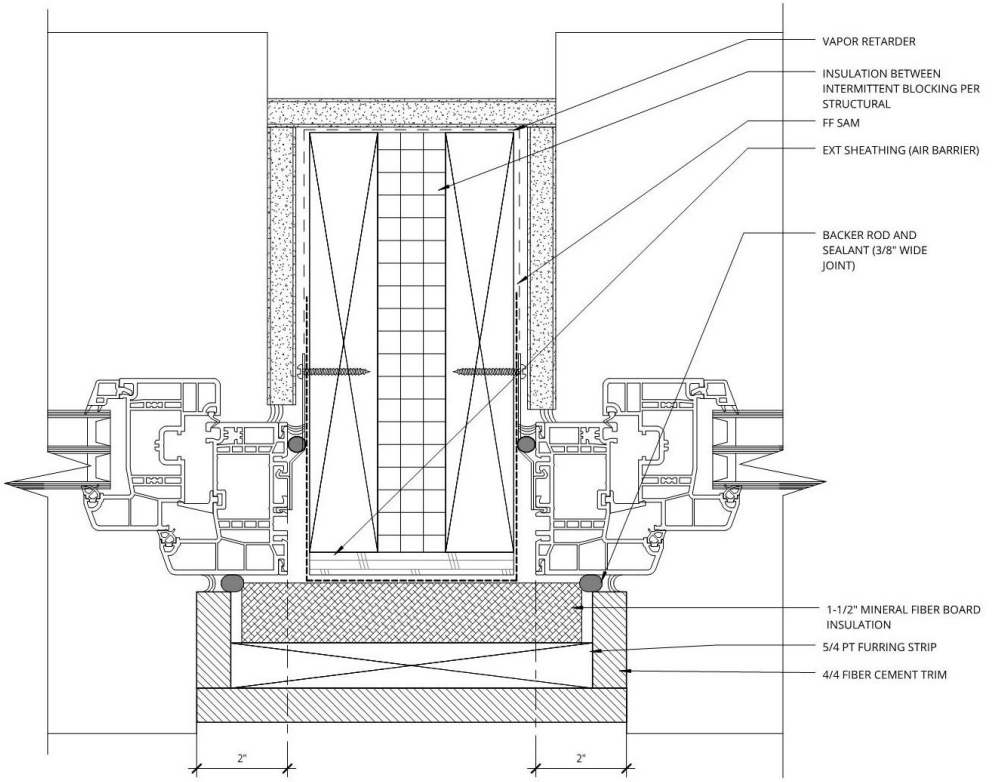

COMMERCIALWRAP
COMMERCIALWRAP
DUPONT The miracles of science.

Component Selection - Windows



2 HORIZONTAL SDL45 @ TRIPLE GLAZING
ARCH. REF:

Component Selection - Windows



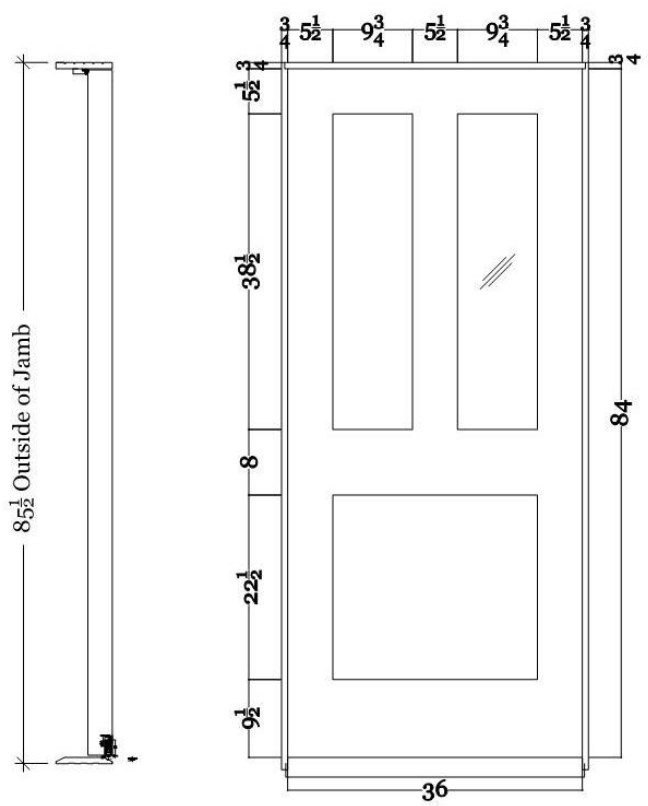
Component Selection - Doors

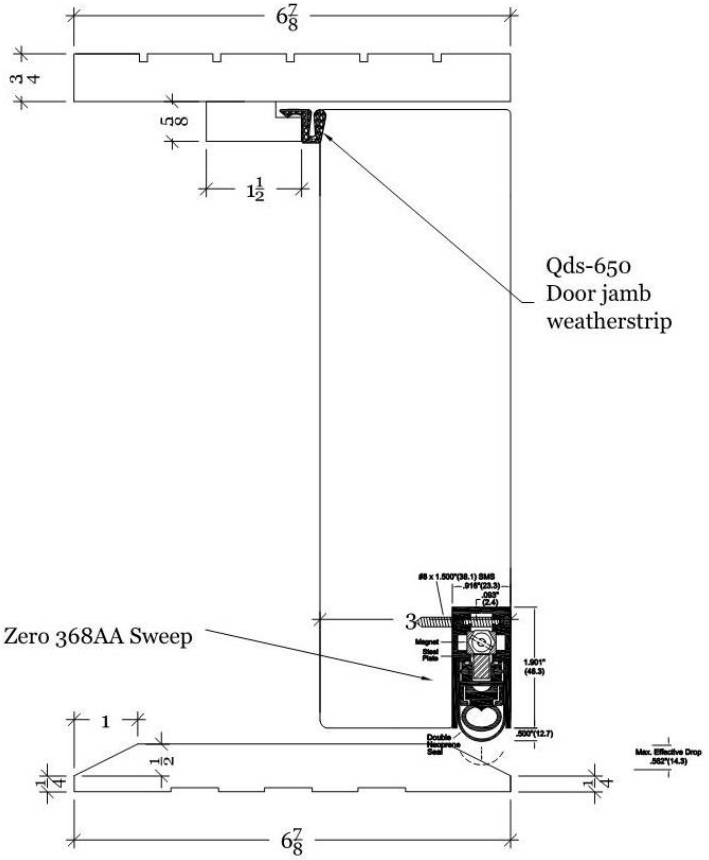
DOOR WISH LIST

- 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

Component Selection - Doors

Component Selection - Doors

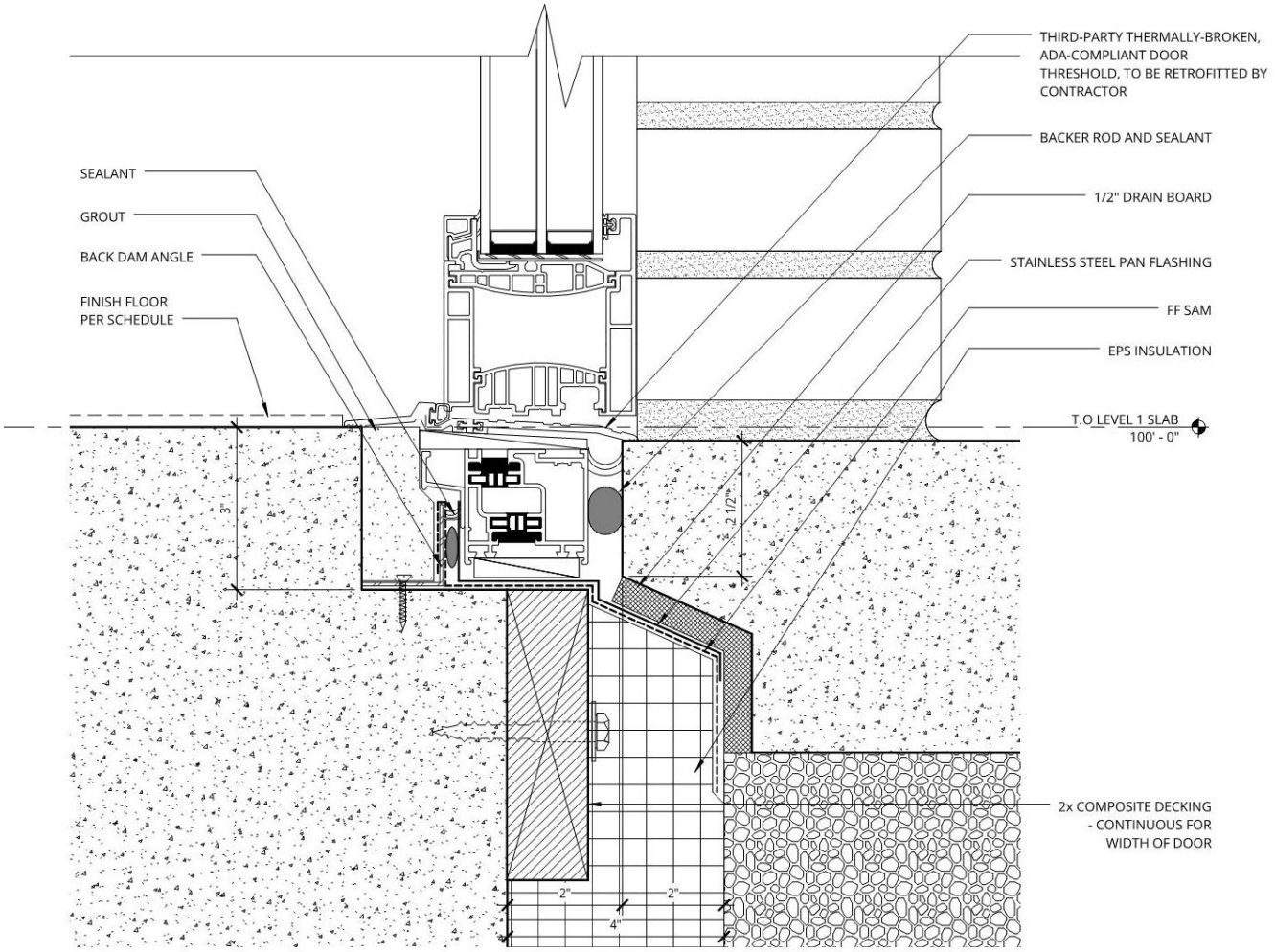




Custom Wood Door by Select Door

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

Component Selection - Doors



Entry Door Threshold Detail

Component Selection – Lighting & Appliances

Lighting Design/Considerations

- Pinned fluorescent lighting in units
  - Discourages tenants from replacing lamps w/ less efficient incandescent bulbs
- 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

Passivhaus Approach

- Maximize cost-effective energy reduction
- Developed by team of German physicists in 1990's
- Continuation of US super-insulation and passive solar developments

Invest in this…

~1000 W

…so we can heat with this amount of energy

green hammer
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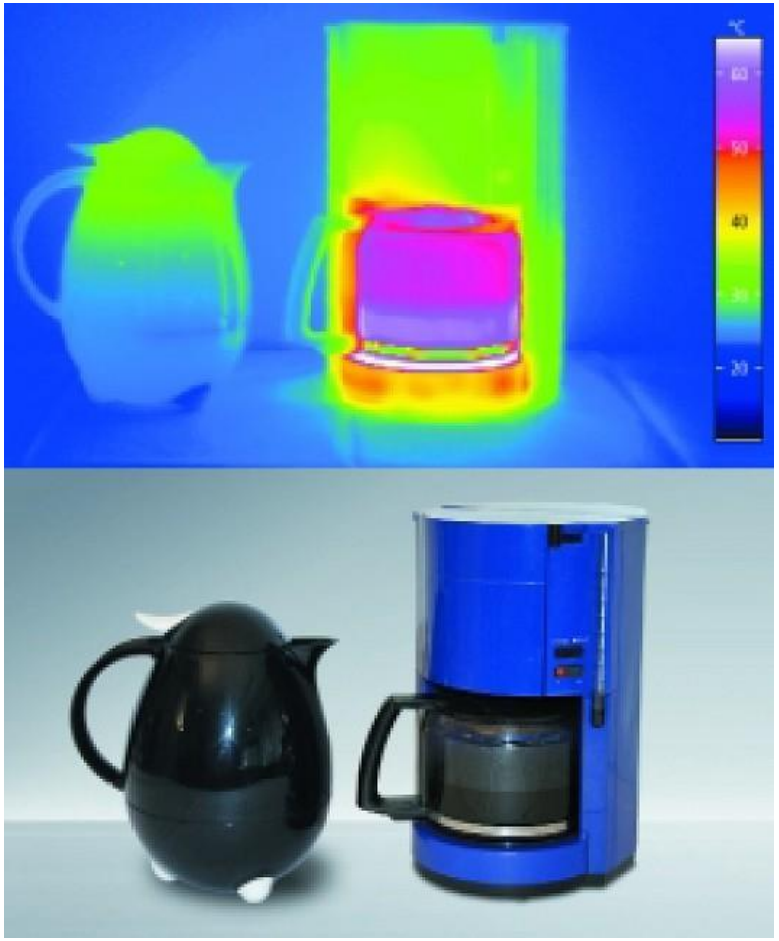
Passivhaus Approach



Source: Passivhaus Institut

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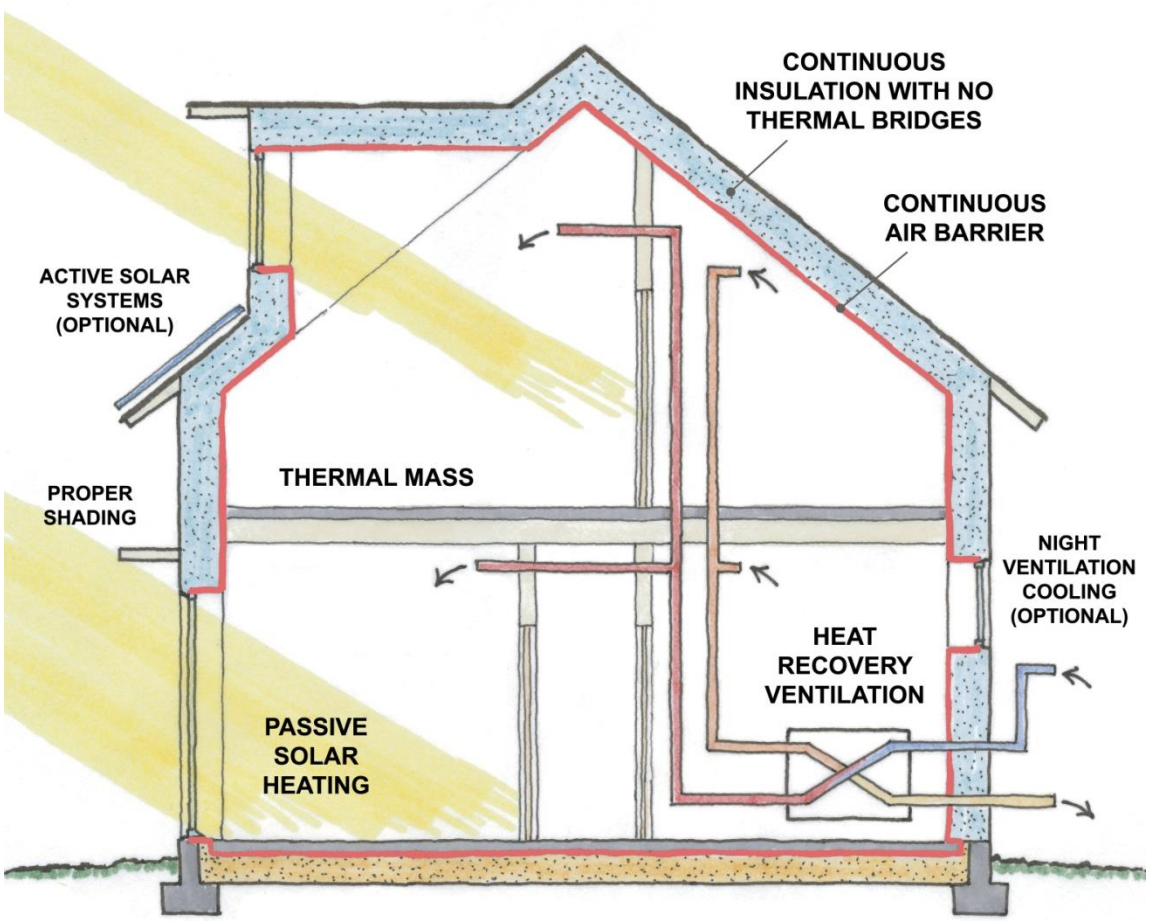
Passivhaus Approach



Typical components of a Passivhaus building

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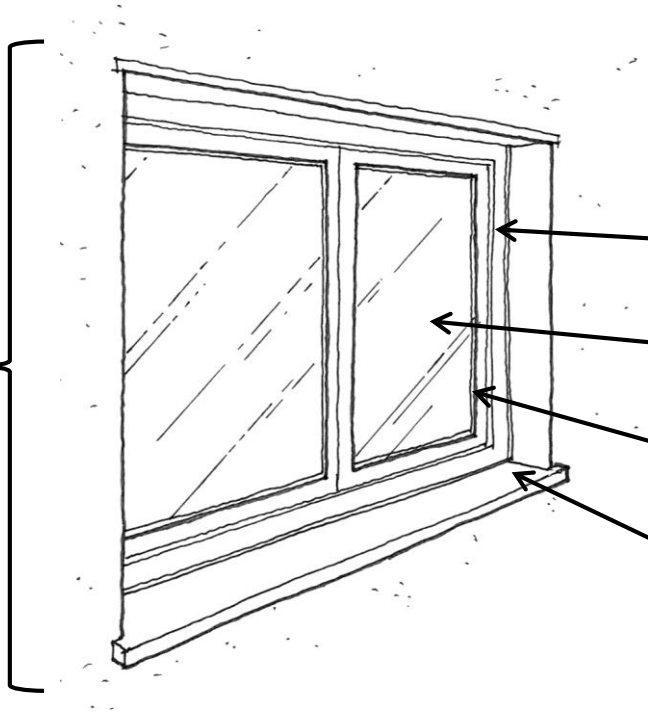
Passivhaus Approach

- Energy modeling tool developed specifically for highly-efficient buildings
- "Passivhaus Planning Package" (PHPP)

Conventional Energy Modeling:
1 Input

U-window



PHPP:
4 Inputs

U-frame

U-glass

Ψ-spacer

Ψ-install

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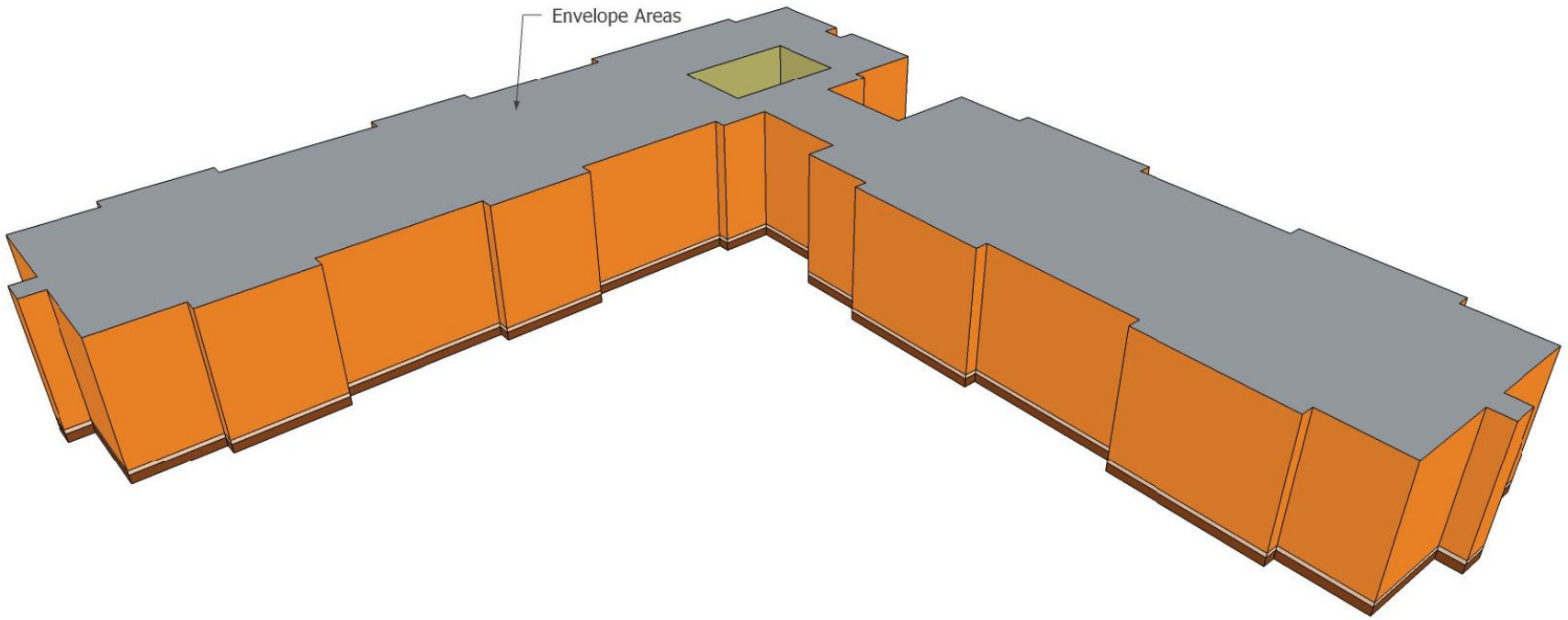
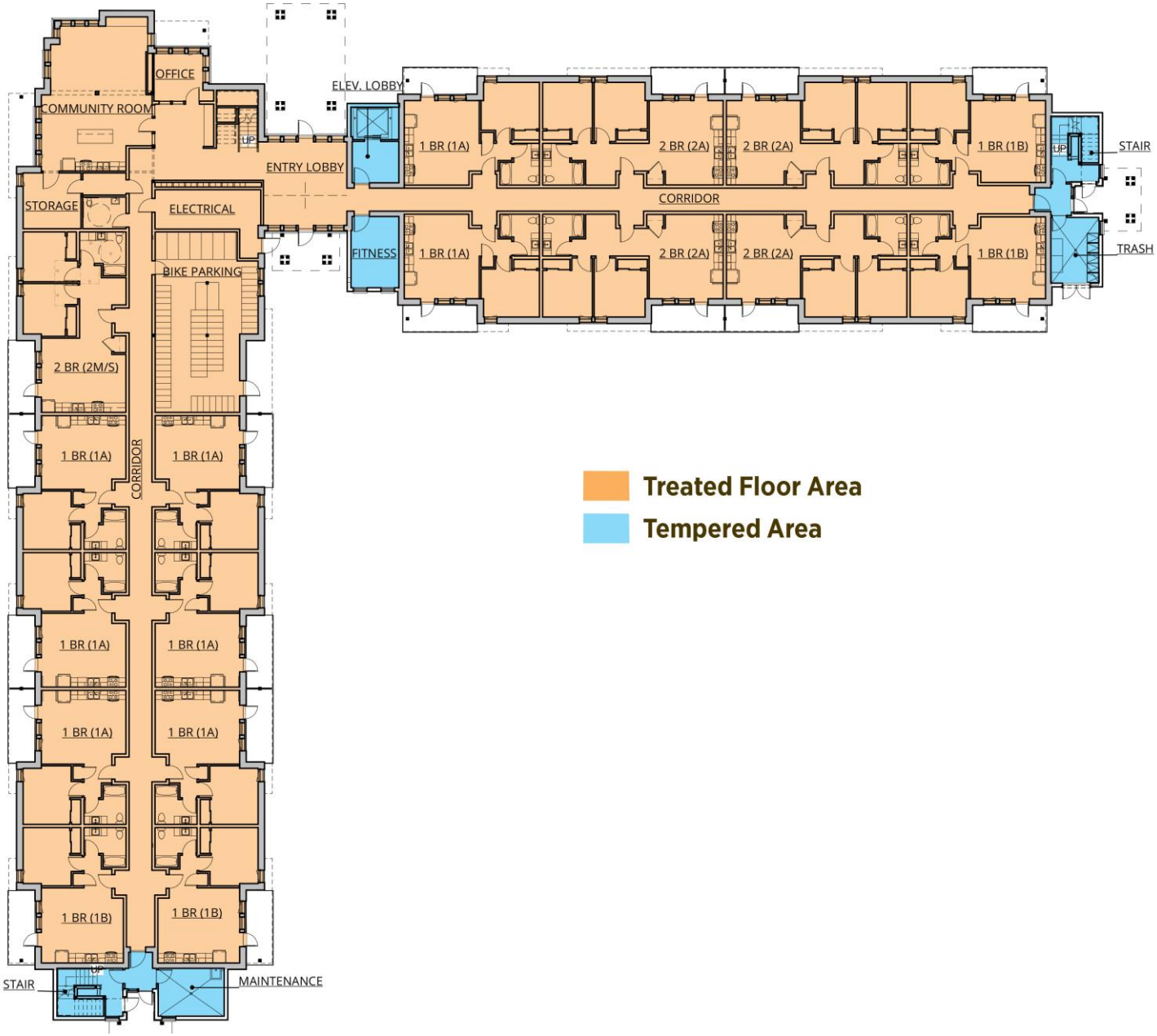
Energy Analysis & Feedback

EARLY PLANNING: AVOID COMPLEXITY




OFFICE
COMMUNITY ROOM
UP
ELEV. LOBBY
ENTRY LOBBY
1 BR (1A)
2 BR (2A)
2 BR (2A)
1 BR (1B)
UP
STAIR
STORAGE
ELECTRICAL
CORRIDOR
FITNESS
1 BR (1A)
2 BR (2A)
2 BR (2A)
1 BR (1B)
TRASH
BIKE PARKING
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)
UP
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”)
- Excel is your friend

For the Heat Demand Target…

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503-804-1746

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) Passivhaus Limit = 4.75 Recommend at this Stage = 4.0	7.05		4.20		3.85		4.24	
Heat Load, Whole Bldg (BTU/hr)	149000		114000		109000		115000	
% Htg Deilverable 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%	

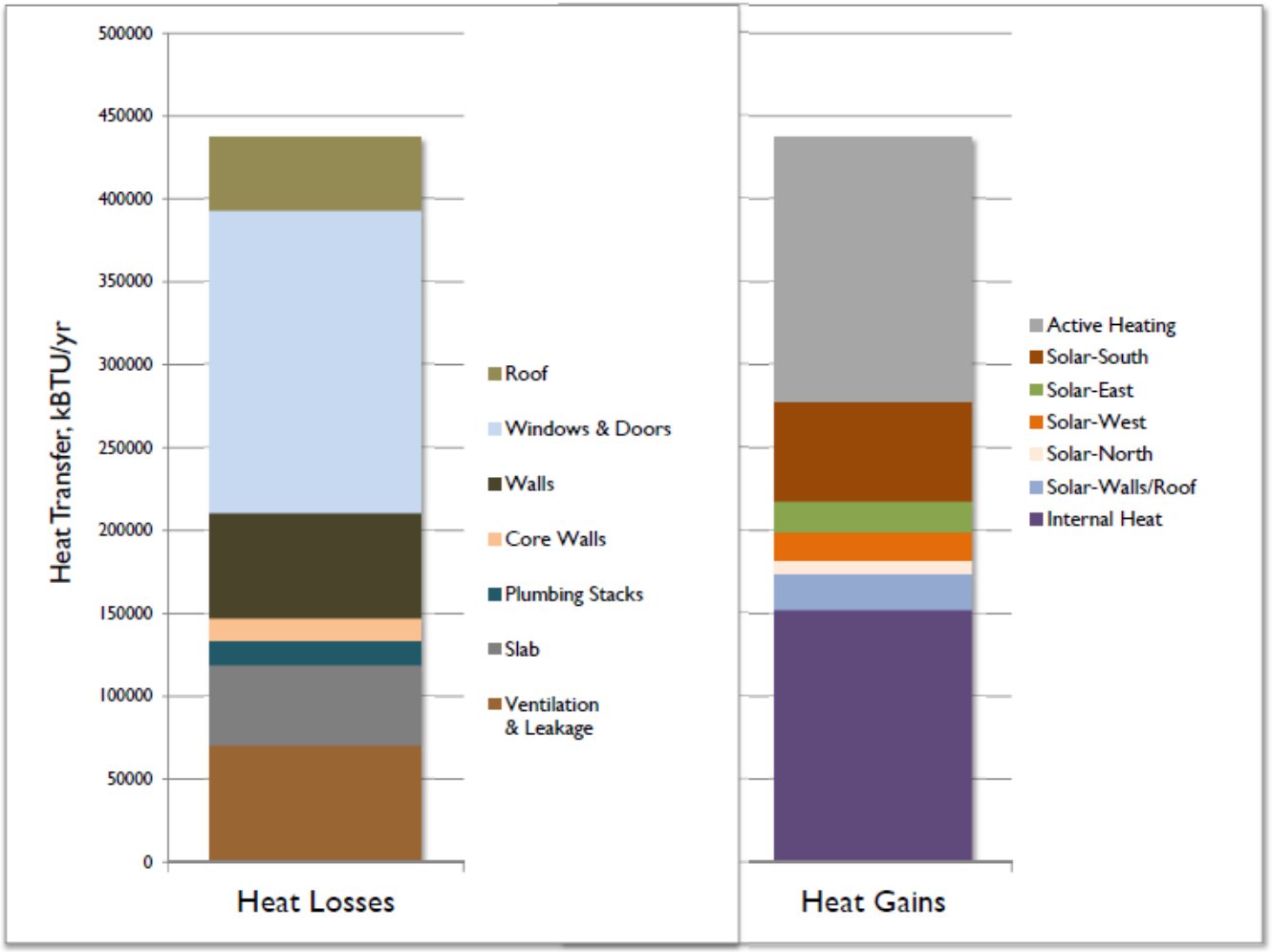
Orenco Station Workforce Housing - Phase I 1/18/12

Heating Energy Analysis (Schematic)

Iteration #3

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

Envelope Thermal Gain & Loss, Heating Season



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	

Narrowing In can take a while…

The Orchards at Orenco - Phase I
Passivhaus Energy Modeling

PHPP Schematic Design Results - CFC Application Iterations

3/14/2012

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Iteration / Item	#7 Thick Windows (New Window Schedule)	R-value	#8 Thick Wall (New Window Schedule)	R-value		#9a CFC App Iterations Wall B,C,D + Cascadia + 80cfm	R-value	#9b CFC App Iterations Wall B,C,D + Cascadia + 60cfm	R-value	#9c CFC App Iterations Wall B,C,D + Zola + 60cfm	R-value	#10a CFC App Iterations Wall E + Cascadia + 80cfm	R-value	#10b CFC App Iterations Wall E + Cascadia + 60cfm	R-value	#10c 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	5.9	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	5.9	Casc 301 T/T Door overinsul	4.7	Casc 301 T/T Door overinsul	4.7	uPVC T/T Door overinsulated	5.9
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 Gypcrete flr w/o carpet		Dbl Drywall Walls & Ceilings Gypcrete flr w/o carpet			Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet		Dbl 5/8" Drywall Walls & Ceilings 1 1/2" Gypcrete flr w/o carpet	
Ventilation Rate (ACH)	0.32		0.32			0.87 ACH		0.65 ACH		0.65 ACH		0.87 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	88% (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: (8) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (8) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (8) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (8) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (8) 2x12, 24" stud bays filled with SPF		Plumbing/Downspout Stacks: (8) 2x12, 24" stud bays filled with SPF	
Heat Demand, Annual (kBTU/sf) Passivhaus Limit = 4.75 Recommend at this Stage = 3.8	**3.83**		**3.82**			**5.51 kBTU/sf.yr**		**4.88 kBTU/sf.yr**		**4.08 kBTU/sf.yr**		**4.92 kBTU/sf.yr**		**4.30 kBTU/sf.yr**		**3.52 kBTU/sf.yr**	
Heat Load, Whole Bldg (BTU/hr)	104395		103183			112789 BTU/hr		105356 BTU/hr		95652 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** 9.9 kWh/sf.yr		**10.3 kWh/sf.yr** 9.1 kWh/sf.yr		**10.1 kWh/sf.yr** 8.9 kWh/sf.yr		**10.9 kWh/sf.yr** 9.7 kWh/sf.yr		**10.1 kWh/sf.yr** 9.0 kWh/sf.yr		**9.9 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.

And for the Primary Energy Target…

The Orchards at Orenco - Phase I

Scenario Descriptions

green hammer
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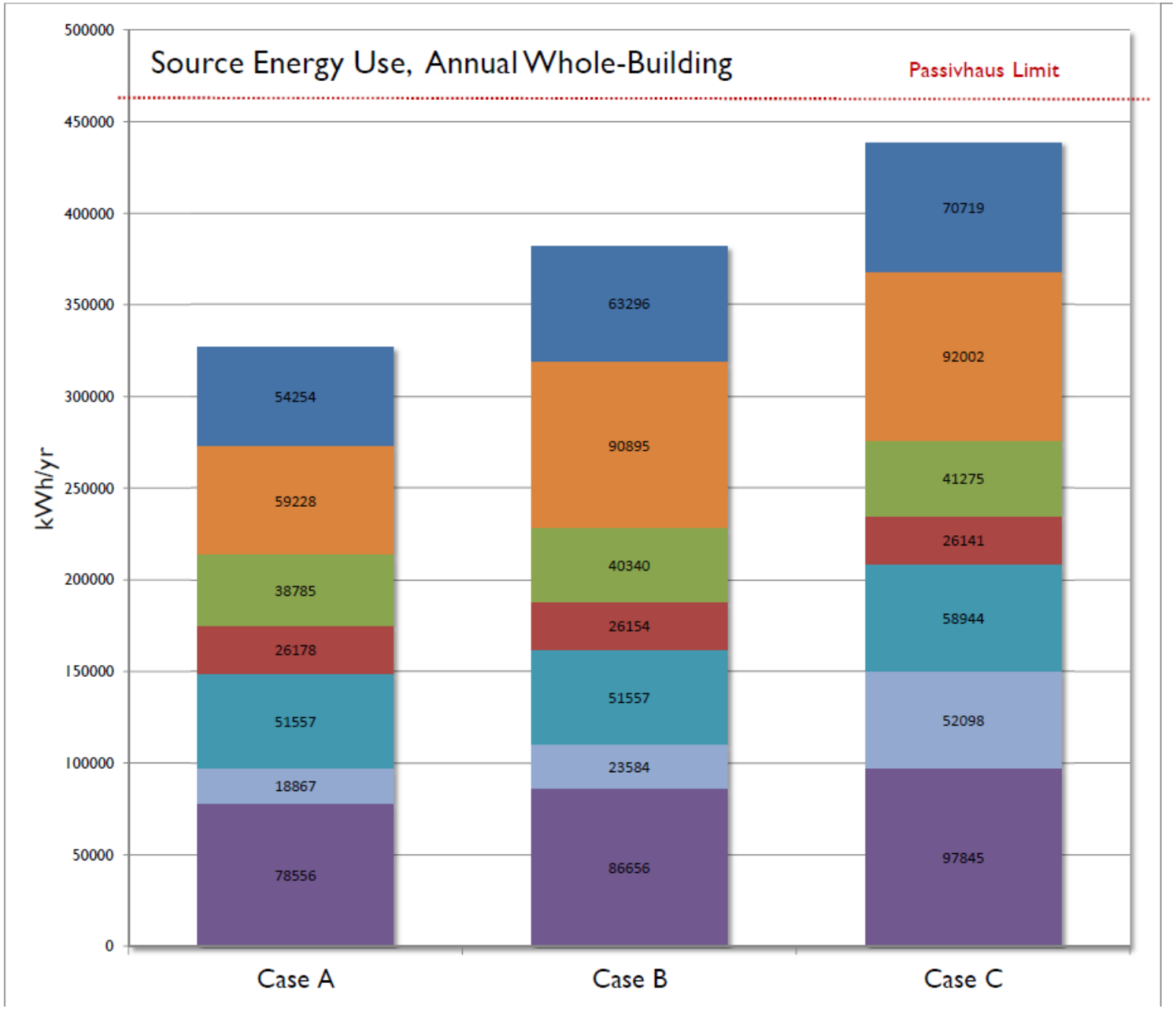
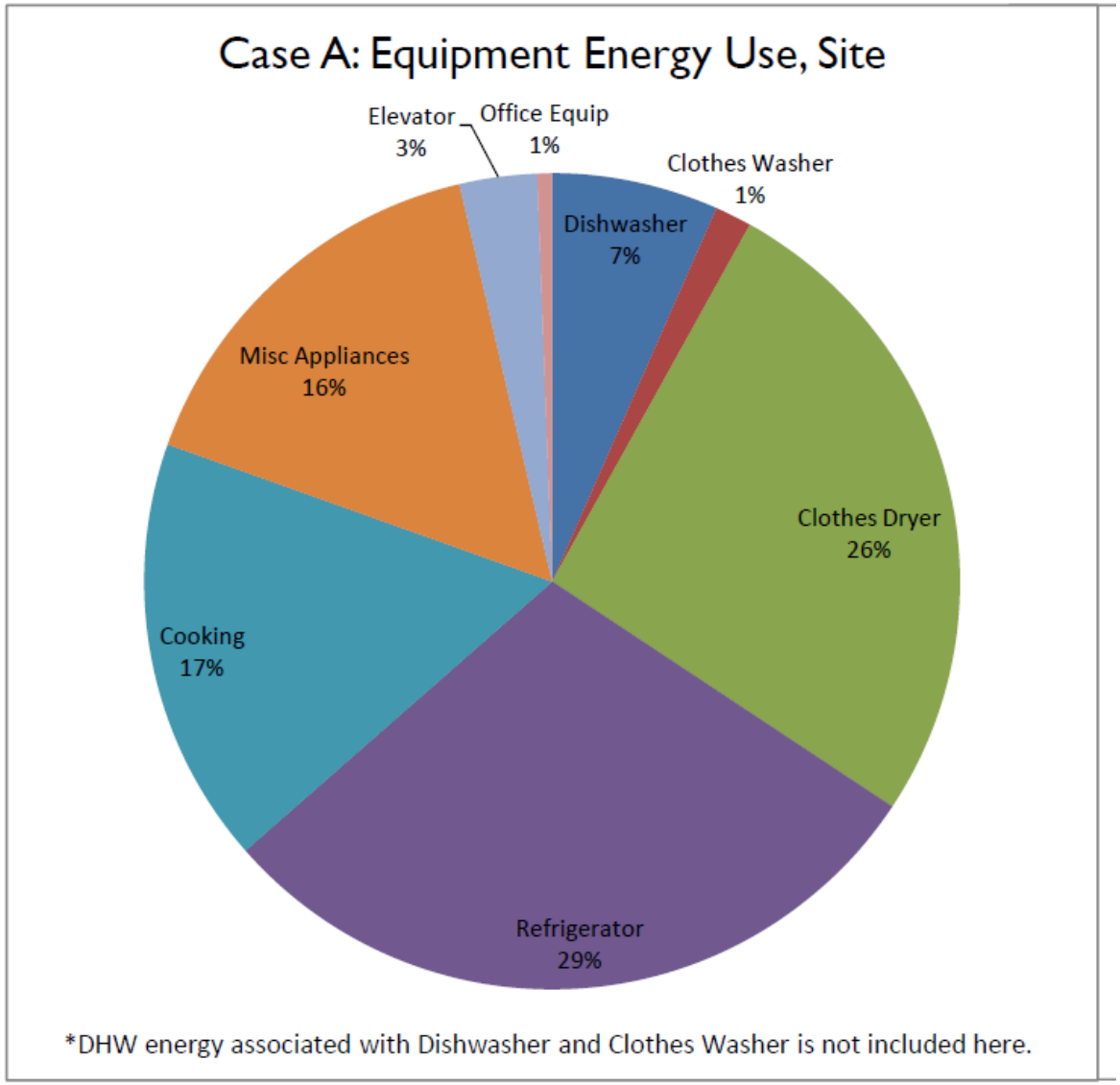
	Case A	Case B	Case C
Space Heating	80% via Heat Pump, COP=4.0 i.e. Daikin Altherma 20% via Elec Resistance	80% via Heat Pump, COP=3.0 i.e. Mini-Split 20% via Elec Resistance	80% via Gas Boiler, 93% eff. 20% via Elec Resistance
Water Heating	Heat Pump, COP=4.0 i.e. Daikin Altherma	Gas Boiler, 93% eff.	Gas Boiler, 93% eff.
Lighting	0.4 - 0.8 W/sf	0.4 - 0.8 W/sf	0.4 - 0.8 W/sf
Equipment			
Elevator	Tration, MRL i.e. Kone	Traction, Geared	Hydraulic
Appliances	10th Percentile Energy Star	10th Percentile Energy Star	50th Percentile Energy Star
Clothes Dryers	Gas w/ Drying Racks in Units	Gas	Electric
Ventilation	ECM Fan i.e. Zehnder or Ultimate Air	ECM Fan i.e. Zehnder or Ultimate Air	ECM Fan i.e. Zehnder or Ultimate Air


Source Energy Use, Annual Whole-Building
Passivhaus Limit
kWh/yr
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
54254
59228
38785
26178
51557
18867
78556
63296
90895
40340
26154
51557
23584
86656
70719
92002
41275
26141
58944
52098
97845
Case A
Case B
Case C

Equipment Energy Use Breakdown



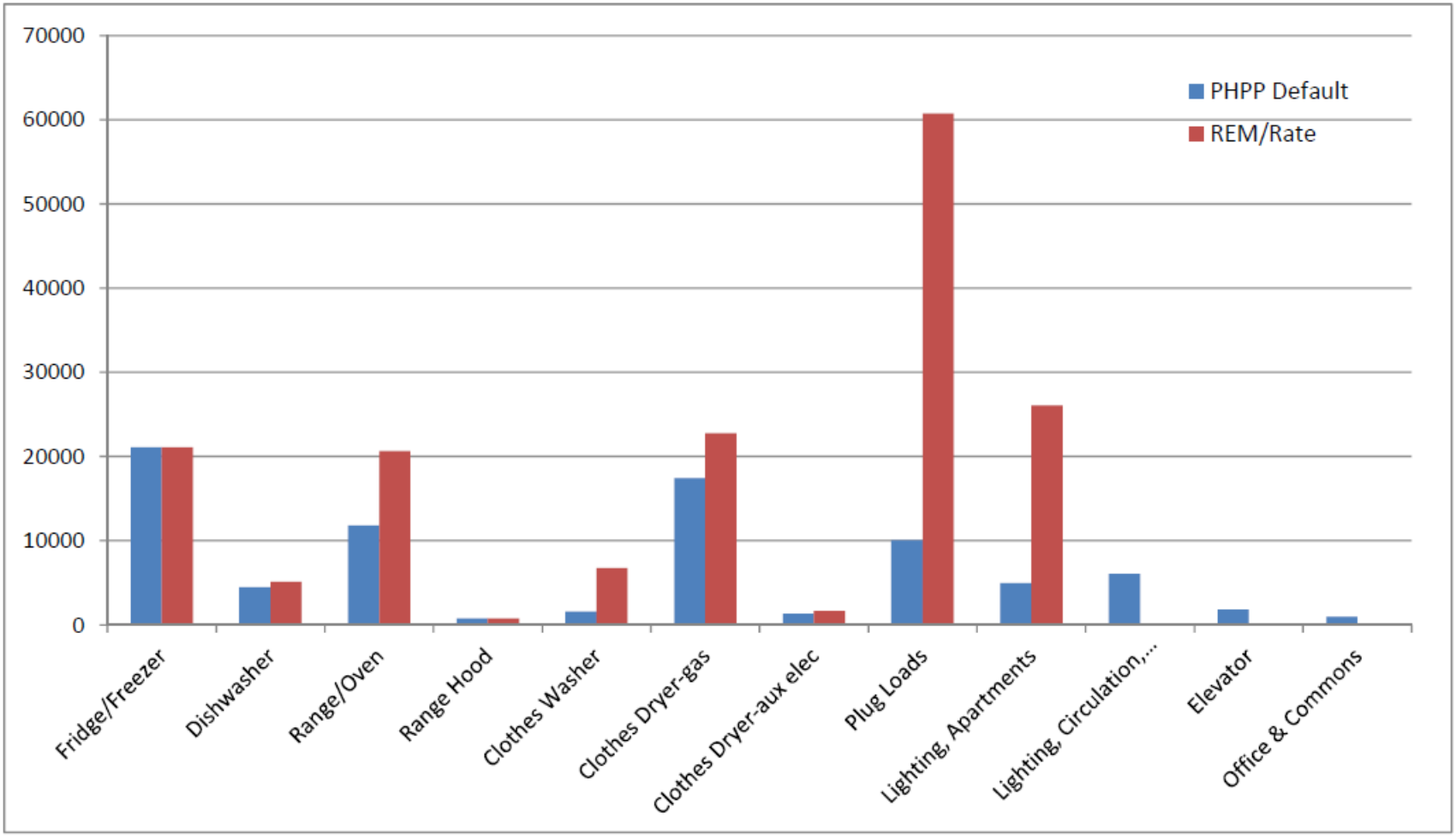
Narrowing in on Appliance "Energy Budgets"…

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

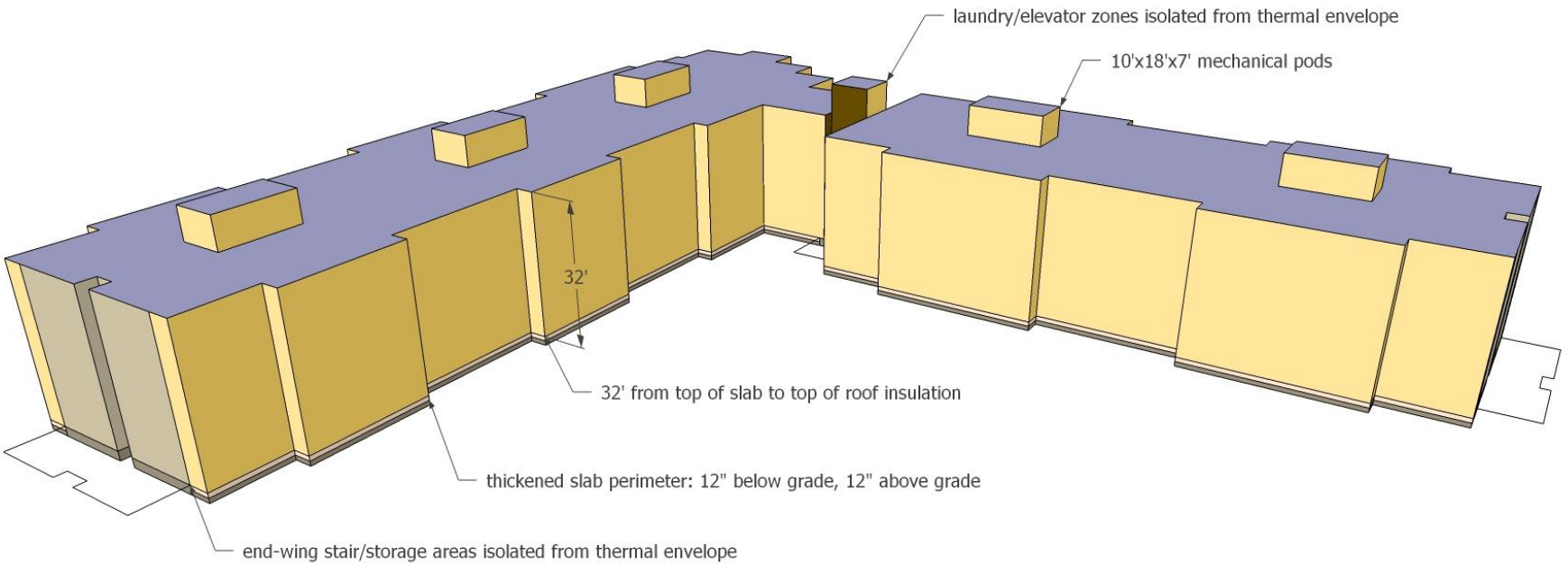
Reality check on Plug Loads…



Energy Analysis & Feedback

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

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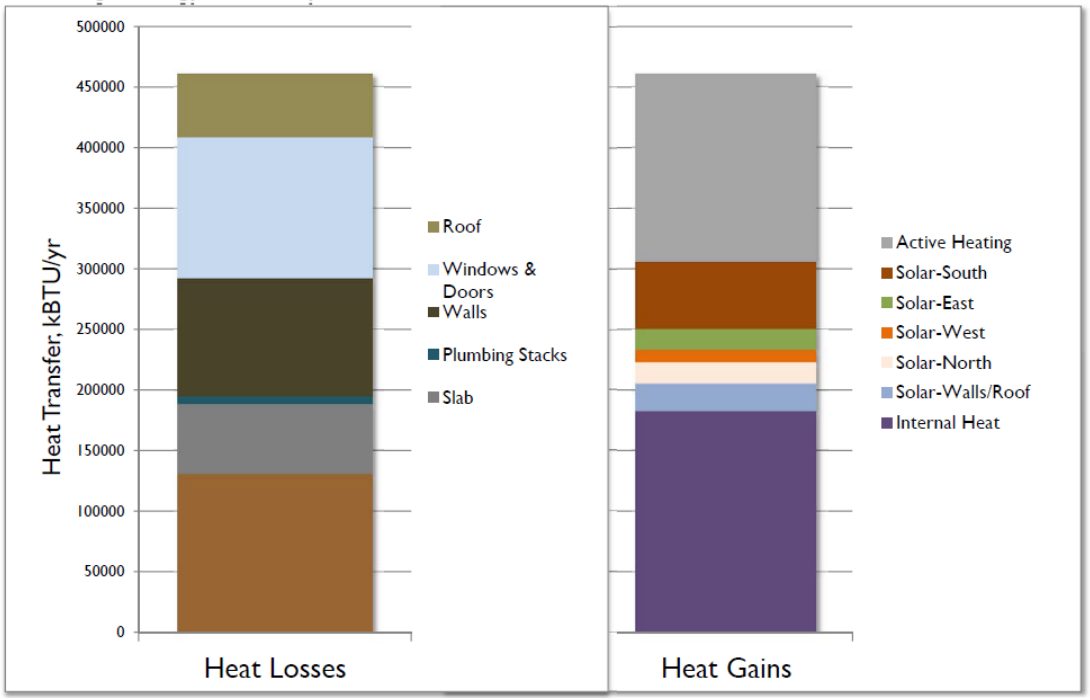
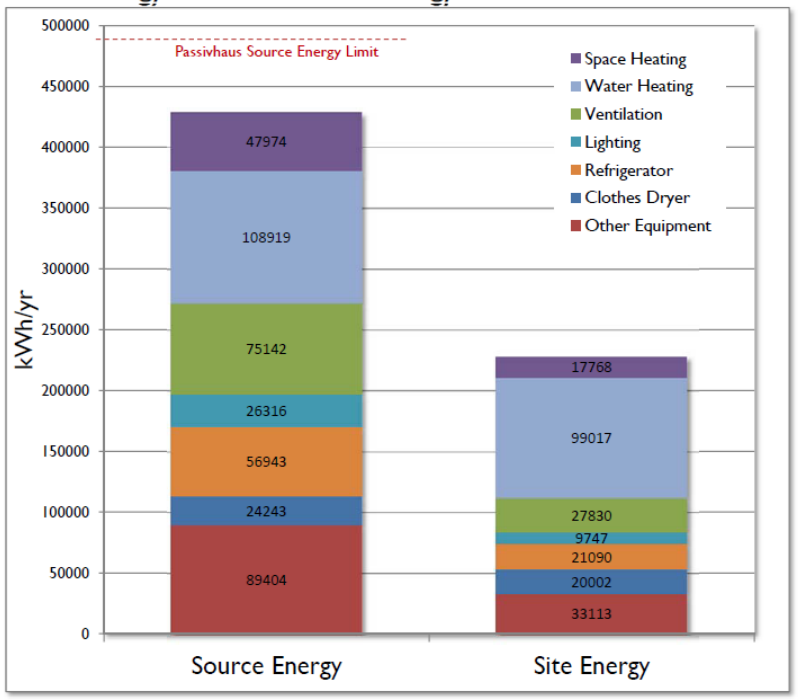
Heating Energy: Envelope Thermal Gain & Loss



Total Energy: Source & Site Energy Use



CONSTRUCTION DRAWINGS: KEEP CHECKING IN WITH THE MODEL

The Orchards at Orenco - Phase I

Passive House Energy Analysis Summary

Euroline Scenario (50% CD Set)

12/24/2013

Holiday Edition!

green hammer
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RESULTS:

Space Heating EUI:	4.24	kBTU/sf.yr	Total Source Energy EUI:	34.4	kBTU/sf.yr
Passive House Standard:	4.75	kBTU/sf.yr	Passive House Standard:	38.0	kBTU/sf.yr
Percent of Limit:	89%		Percent of Limit:	91%	

ASSUMPTIONS:

Envelope:

		R-value	
Walls:	2x10 + 1.5" mineral wool advanced framed, 15% framing factor solid blocking @ exterior structural supports	39	
Windows:	EuroLine T/T uPVC overinsulated	7.2	R-frame
Glazing N/S:	LoE 180/180 Ar, SHGC=0.54	7.5	
Glazing E/W:	LoE 366/180 Ar, SHGC=0.24	8.2	
Residential Doors:	Euroline T/T Door uPVC overinsul. ADA sill (assumed 4600 Series)	4.3	R-frame
Glazing:	same as above		
Commercial Doors:	TBD Wood Fire-Rated Door	4.5	R-frame
Glazing:	LoE 366/180 Ar, SHGC=0.24	8.2	
Roof:	12" Polyiso over Sheathing	81	
Slab: Field:	4" EPS II	19	
Interior Footings:	1" EPS IX	6	
Perimeter Footings:	4" EPS IX	20	
Vertical Perimeter:	4" EPS II	19	
Airtightness:	0.60 ACH @ 50 Pa		

Other:

Thermal Mass:	Standard drywall 1 inch gypcrete floor topping w/o carpet Carpet in bedrooms only
Cold Stacks:	Downspouts, Plumbing, Radon vents aggregated in: (8) 2x12, 24" stud bays filled with Dense-pack Cellulose

Heating System: 80% Heat Pump, COP = 4.15 (average all systems)
delivered via HRV supply & indoor heads
20% Electric-Resistance (in apartments)
window watcher shut-off

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

Apartment Ventilation:	50 cfm/apt
Comm. Rm. Ventilation:	0.06 cfm/sf baseline CO2 sensor steps to code max req't
Circulation Ventilation:	0.06 cfm/sf
Whole-Building Ave:	0.58 ACH
Duct Insulation, HRV to Exterior:	4" FG w/ vapor barrier
Fitness/Trash Exhaust:	900 cfm direct exhaust

make-up air inlet provided from exterior to exhausted space
24 hr/day operation
0.3 W/cfm fan efficiency

DHW System: Central Gas Heater w/ Trace Htg on Lines
Water Heater efficiency = 94%
Hot Water Line Insulation:
(11) hot water riser lines as min. 3/4" continuous
Low-flow fixtures throughout

Appliances:

Refrigerator/Freezers:	370 kWh/yr ES rating or better
Dishwashers:	275 kWh/yr ES rating or better
Clotheswashers:	184 kWh/yr ES rating or better
Clothesdryers:	gas (moisture sensing recommended)
Range/Oven:	electric (convection recommended)
Range Hood:	recirculating; charcoal filter
Elevator:	1800 kWh/yr i.e. Kone Ecospace, MRL Traction

Lighting:

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

Cooling Strategy: Windows open night only, closed during day
"Hold-opens" recommended for windows' Turn position
HRV supply air tempered by heat pump; supply temp ~50F
HRV heat recovery bypass automated by thermostat

Energy Analysis & Feedback

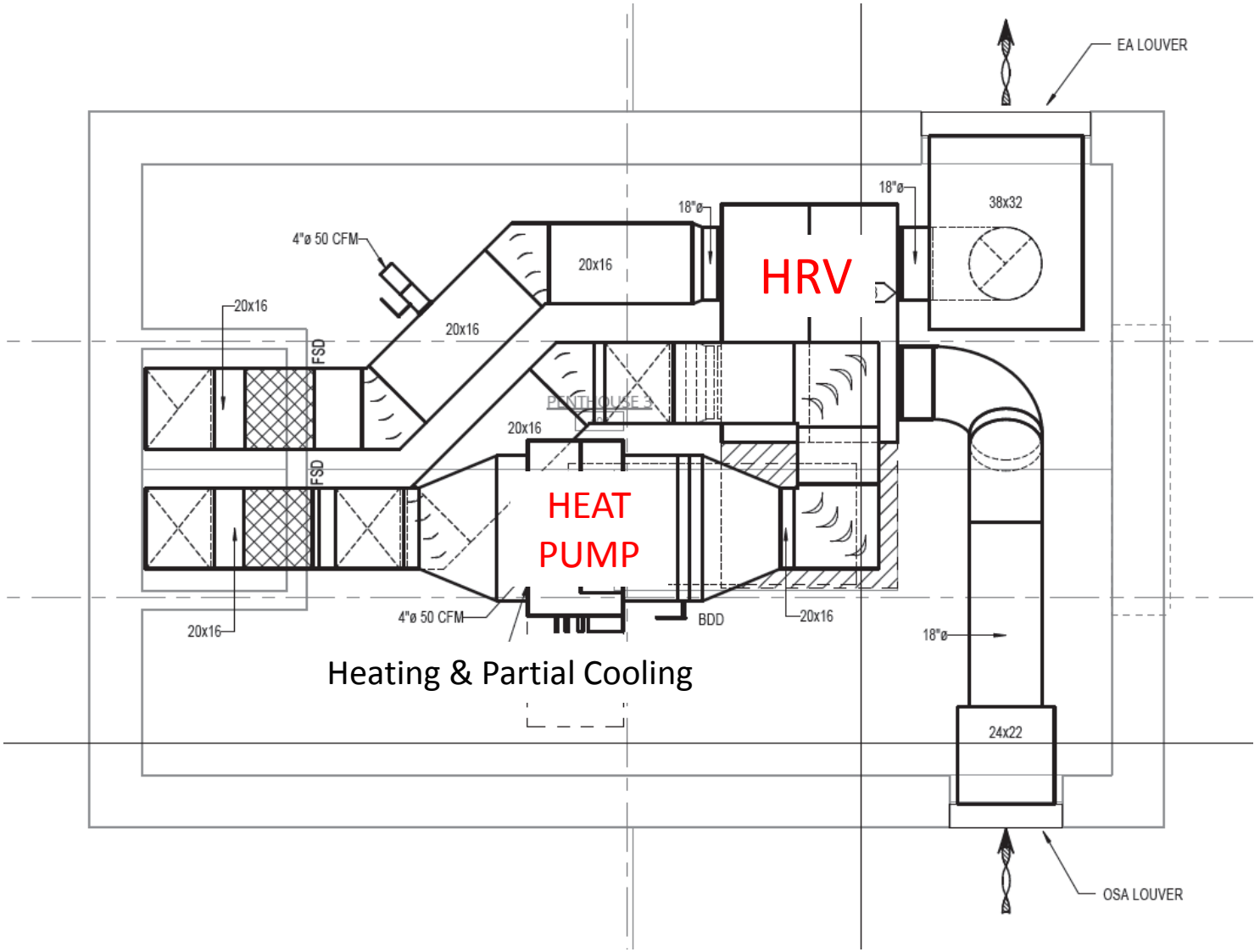
PRECERTIFIED BY GROUND BREAKING!

- Contingency from 20% to 7%
- Appeal necessary to confirm HRV efficiency values
- PHIUS review was timely

Building Systems

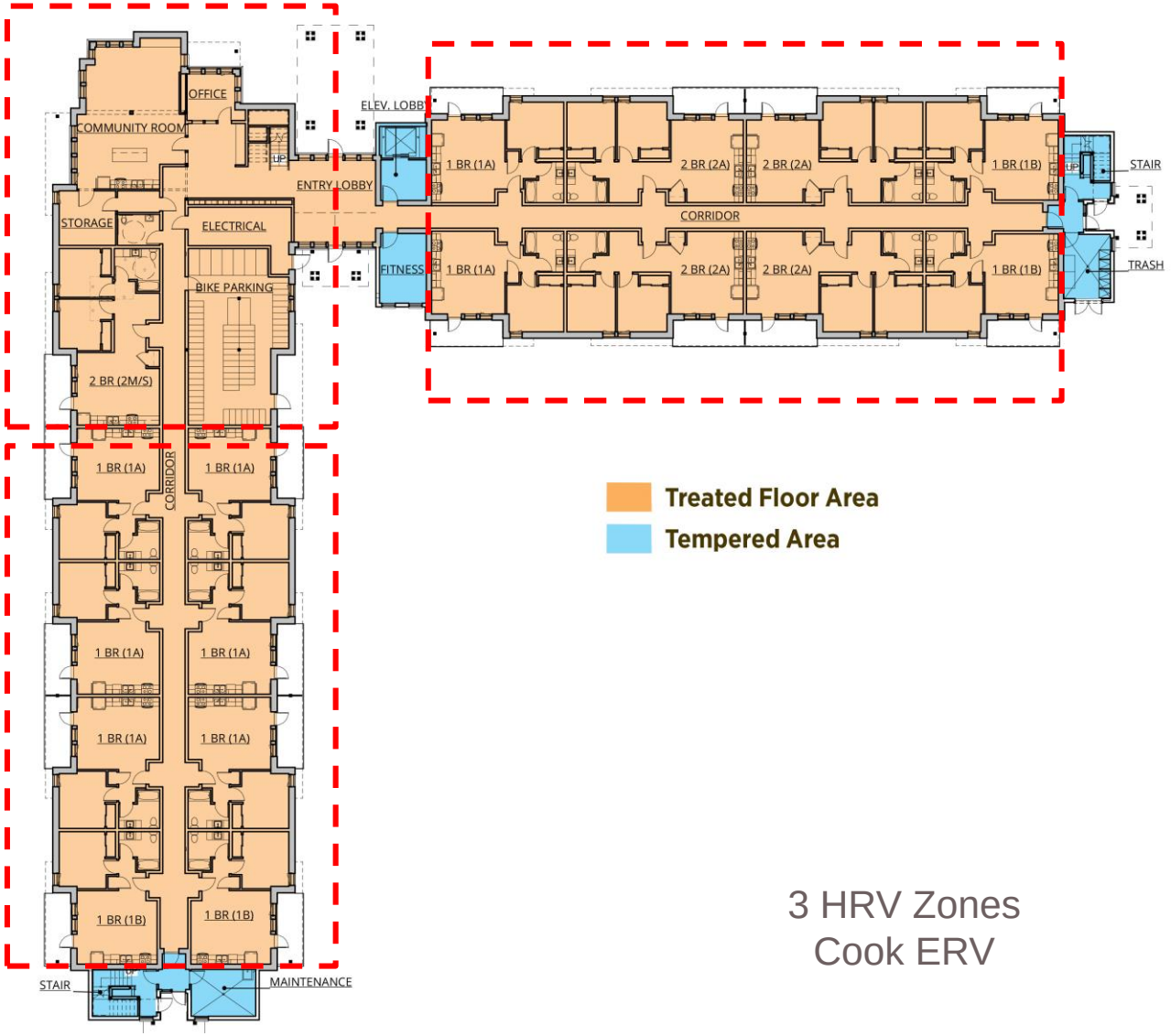
HVAC Design

HVAC Systems



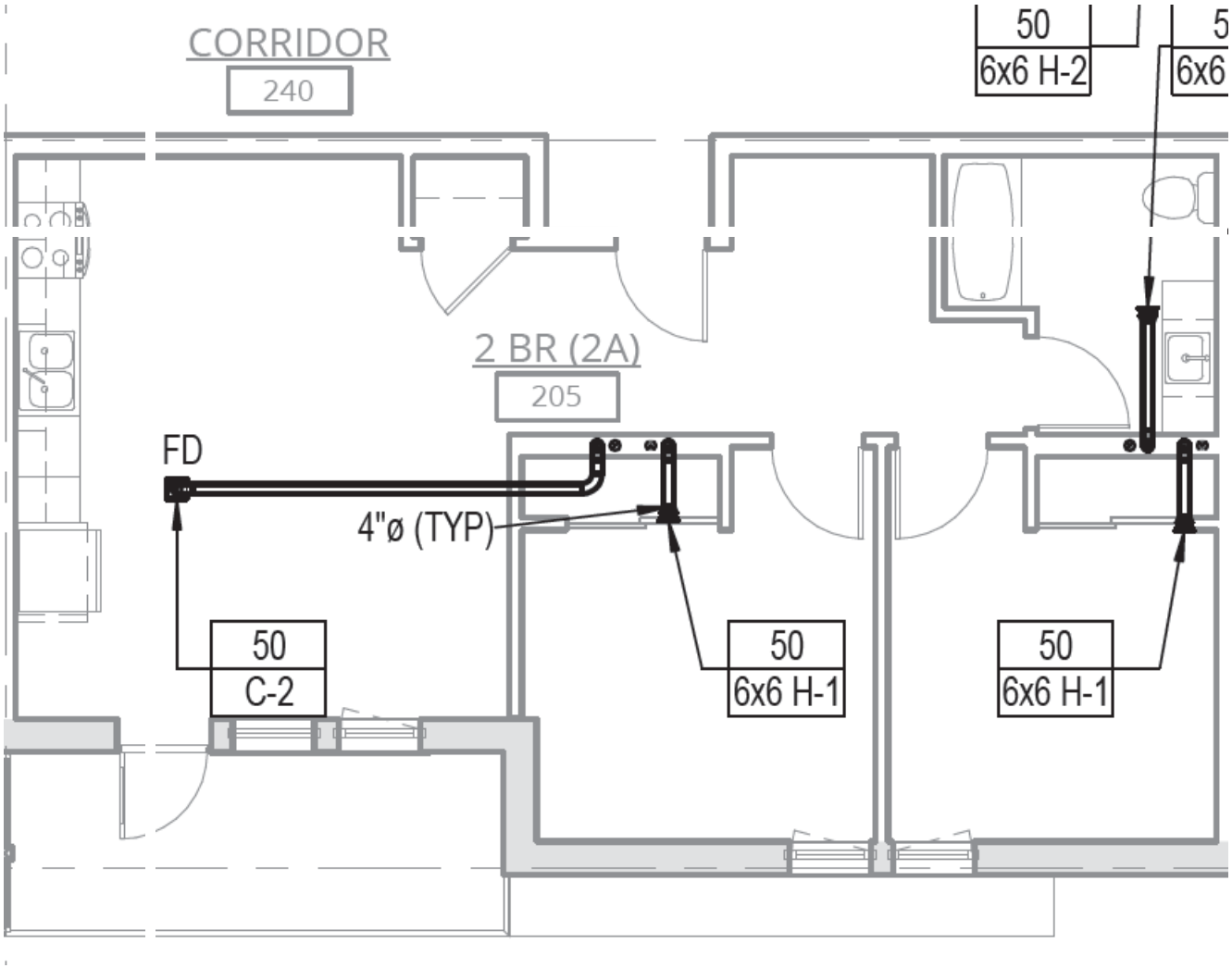
Heating & Partial Cooling

HVAC Design



3 HRV Zones
Cook ERV

HVAC Design



50 cfm supply air per bedroom

Electric cove heater for user control (estimated at 10% of building heating)

Exterior overhangs at all windows

Overheating?

Exterior overhangs at all windows.

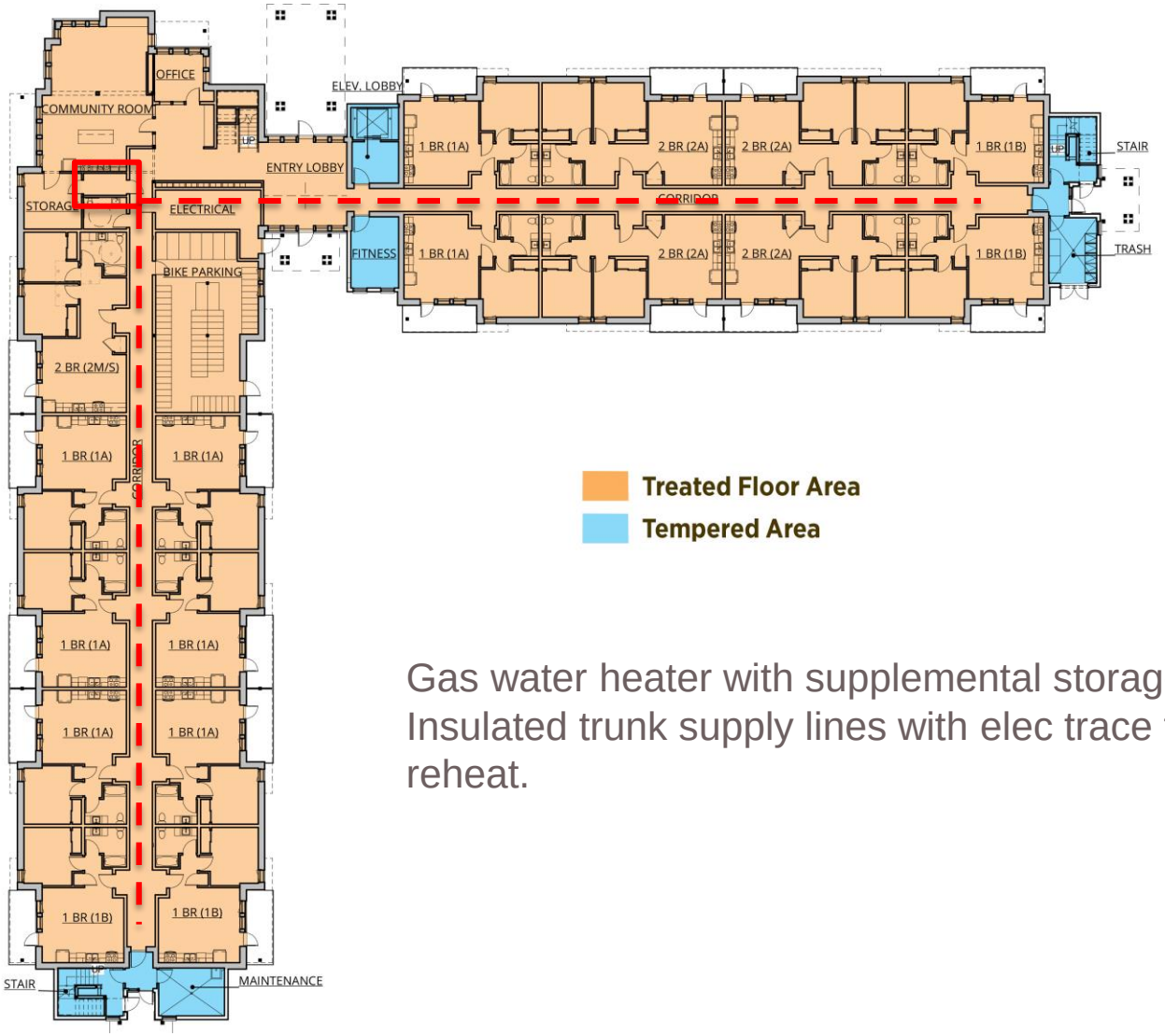
(Also west-facing shade from adjacent building)

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 elec trace tape reheat.

Building Construction

Key Challenges & Considerations

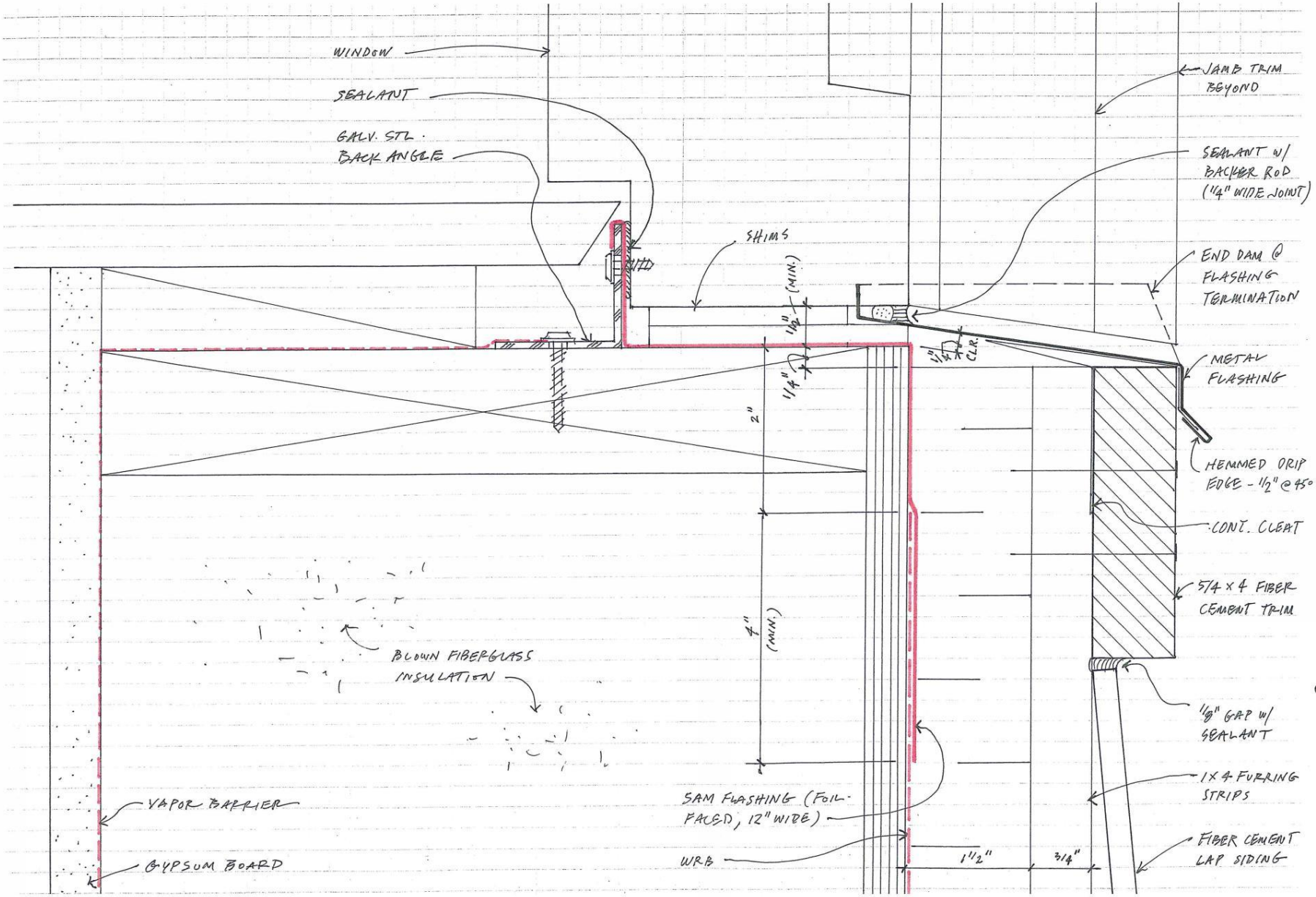
- Cost
  - Pricing new materials and methods
- Constructability
  - Keep it simple! (as possible)
  - Evolution…not revolution
- Product availability / reliability
  - Windows / HRVs
- Coordination of the work
  - Managing subcontractors
- Phasing / Sequencing of work
- Managing quality…

Building Construction

Quality Process

- Construction quality process begins during design…
- Diligent bid process
  - Scope clarifications to bidders
  - Detailed bid proposal review
- Coordination meetings
  - Very early during construction
- Submittals / RFIs
- Mockups
- Passive House trade specialist on GC staff (Envelope & MEP)
- Independent review / inspections (PHIUS+ Rater…and Design Team)


WALSH
Construction Co.

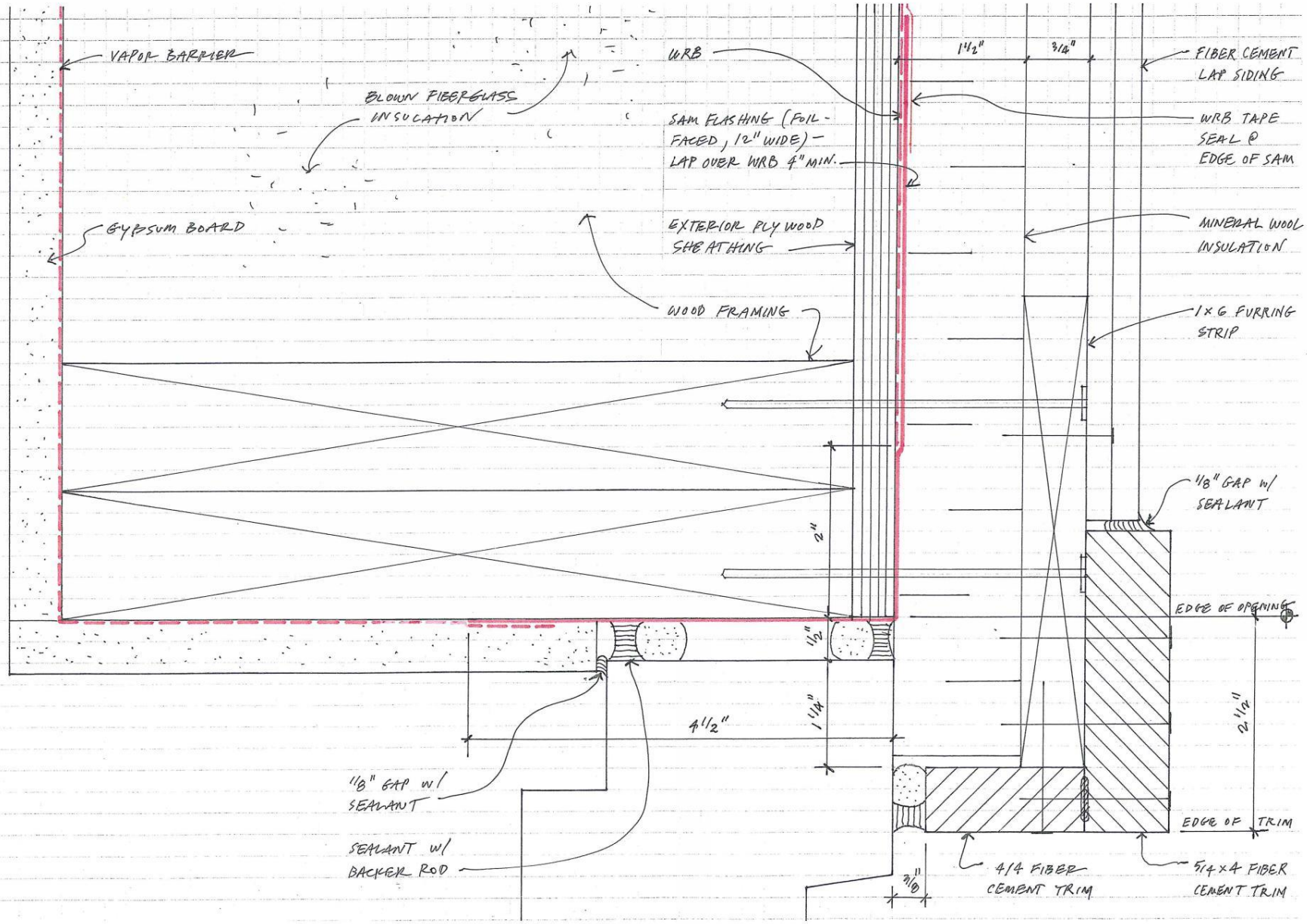


5/12/14 (1)

ORCHARDS @ ORENCO

WINDOW SILL @ LAP SIDING

REF. 19/A4.12

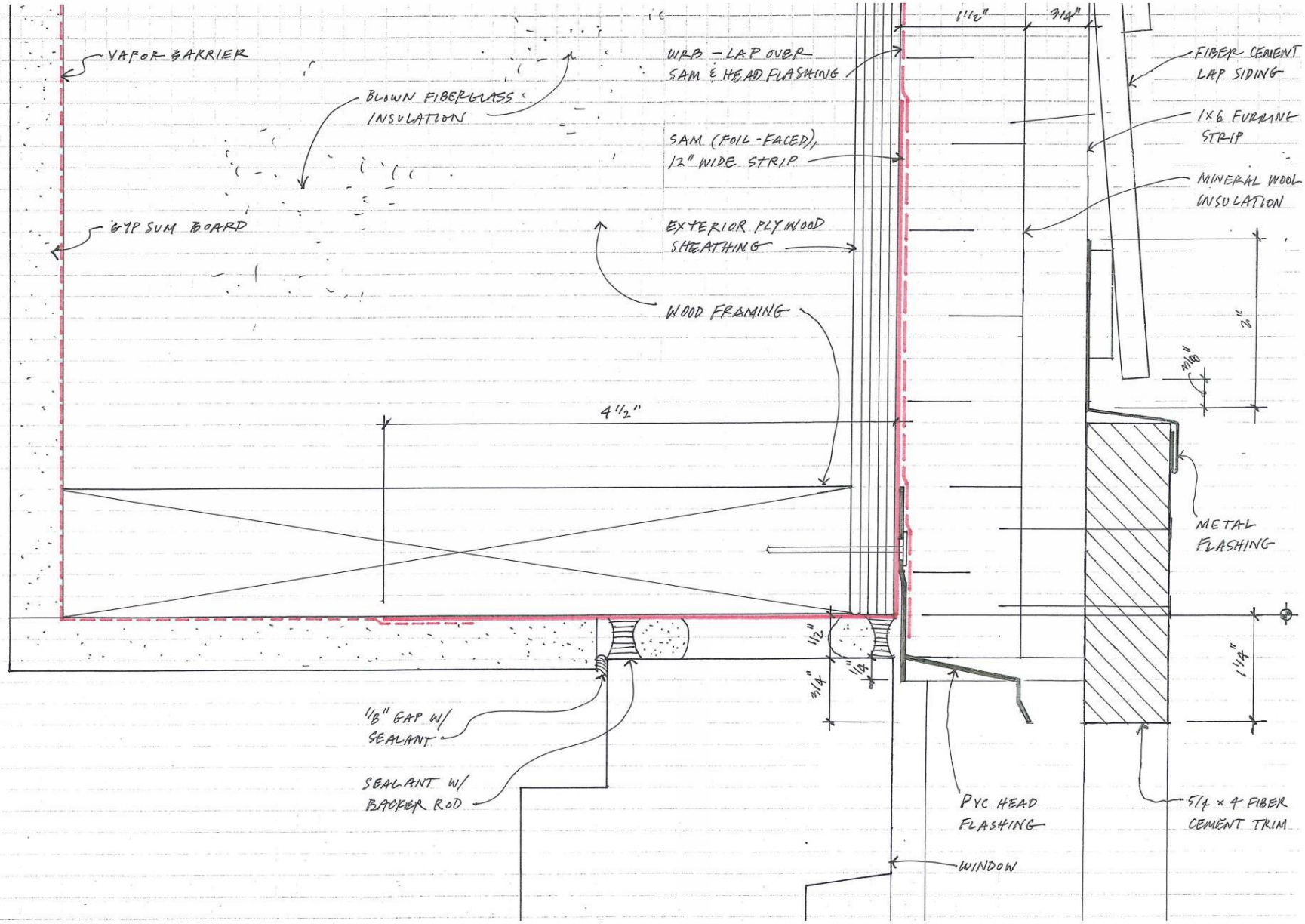


5/12/14 (2)

ORCHARDS @ ORENCO

WINDOW JAMB @ LAP SIDING

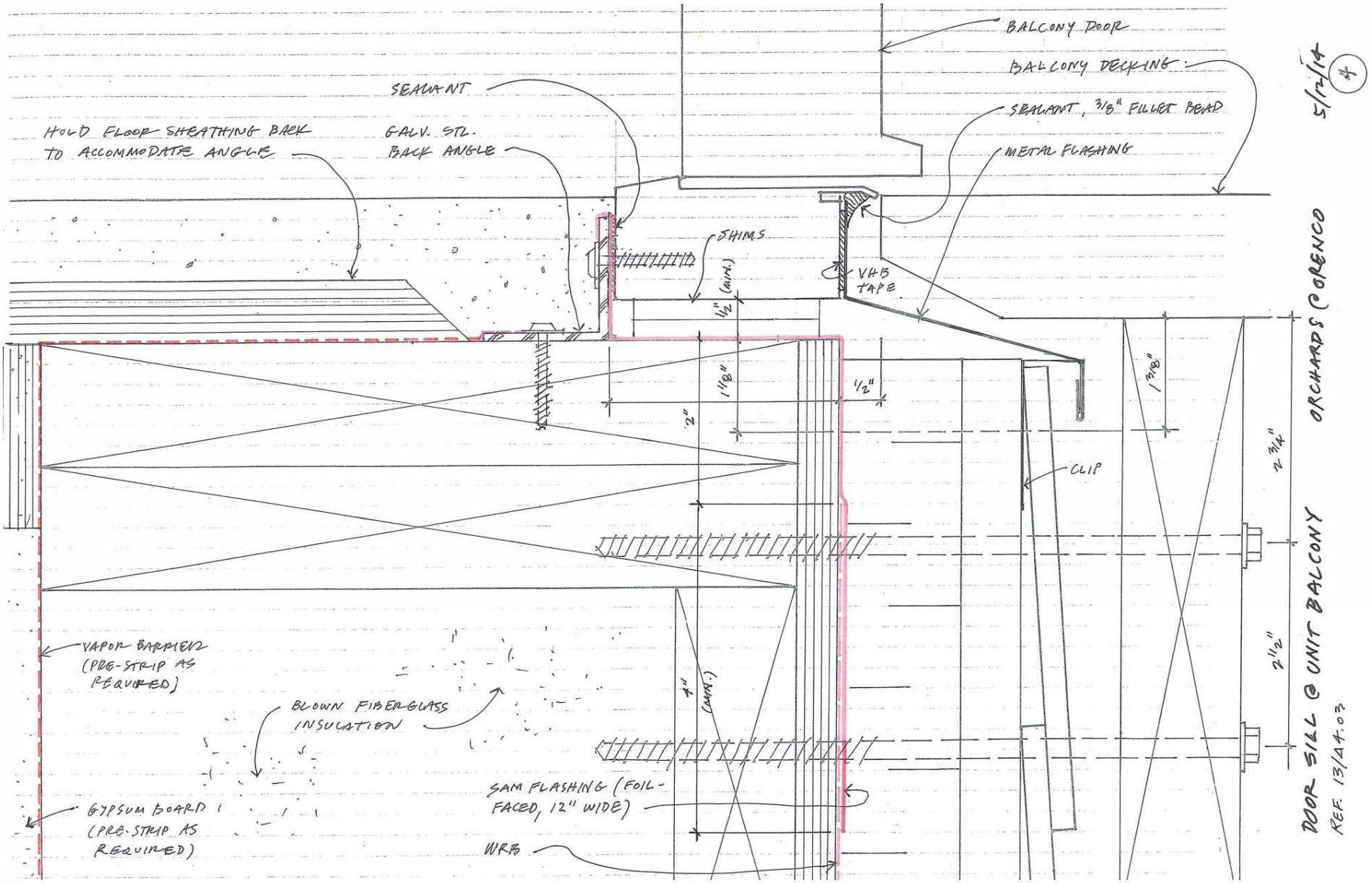
REF. 13/A4.12

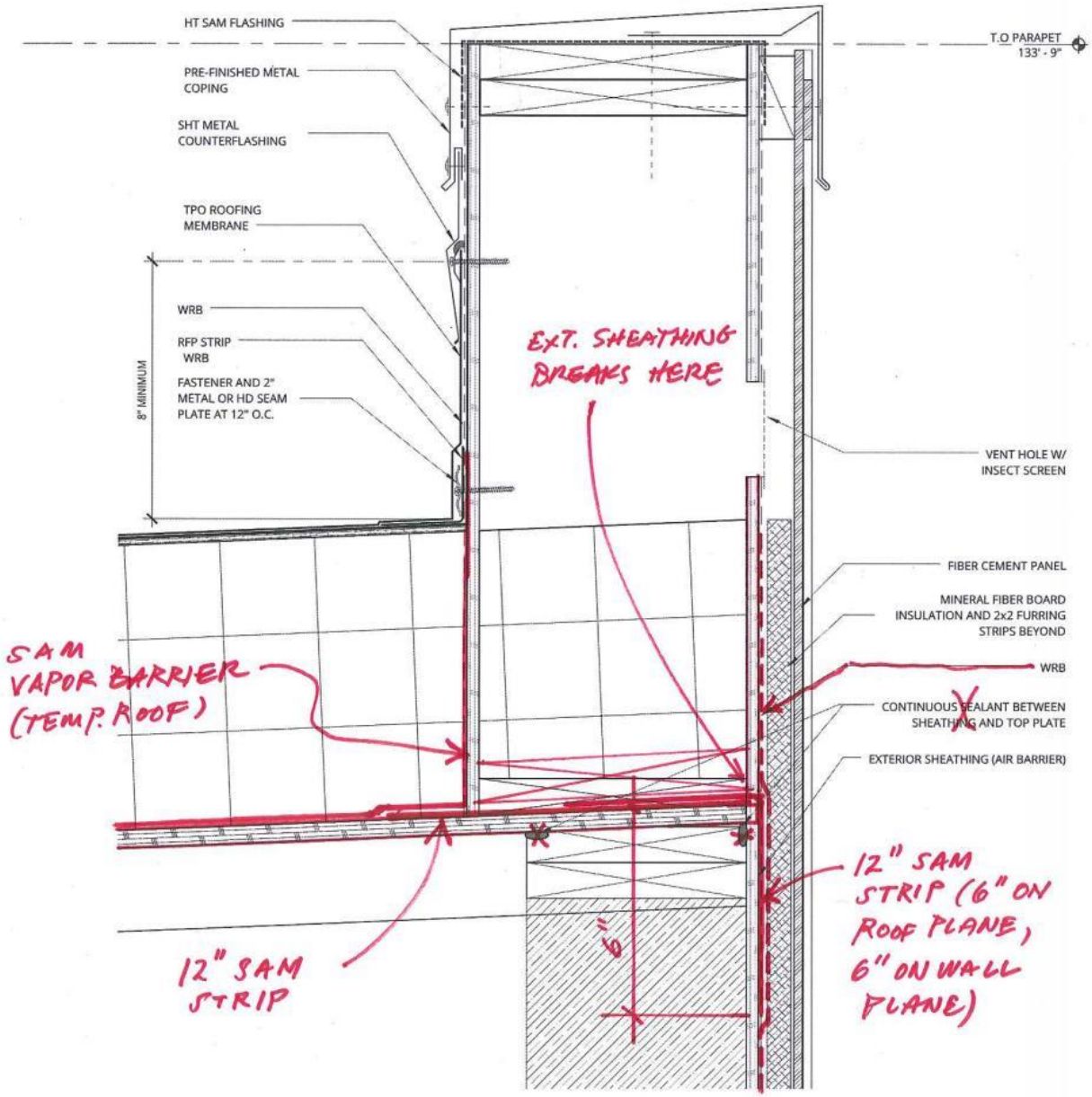


WINDOW HEAD @ LAP SIDING – ORCHARDS @ ORENCO

5/12/14 (3)

REF. 1/A4.12


BALCONY DOOR
BALCONY DECKING
SEALANT
SEALANT, 3/8" FILLET BEAD
METAL FLASHING
HOLD FLOOR SHEATHING BACK TO ACCOMMODATE ANGLE
GALV. STL. BACK ANGLE
SHIMS
VHB TAPE
1/2" (min.)
1 1/8"
1/2"
2"
1 3/8"
2 3/4"
CLIP
2 1/2"
4" (min.)
VAPOR BARRIER (PRE-STRIP AS REQUIRED)
BLOWN FIBERGLASS INSULATION
GYPSUM BOARD (PRE-STRIP AS REQUIRED)
SAM FLASHING (FOIL-FACED, 12" WIDE)
WRB
DOOR SILL @ UNIT BALCONY
REF. 13/A4.03
ORCHARDS CORENCO
5/12/14
4



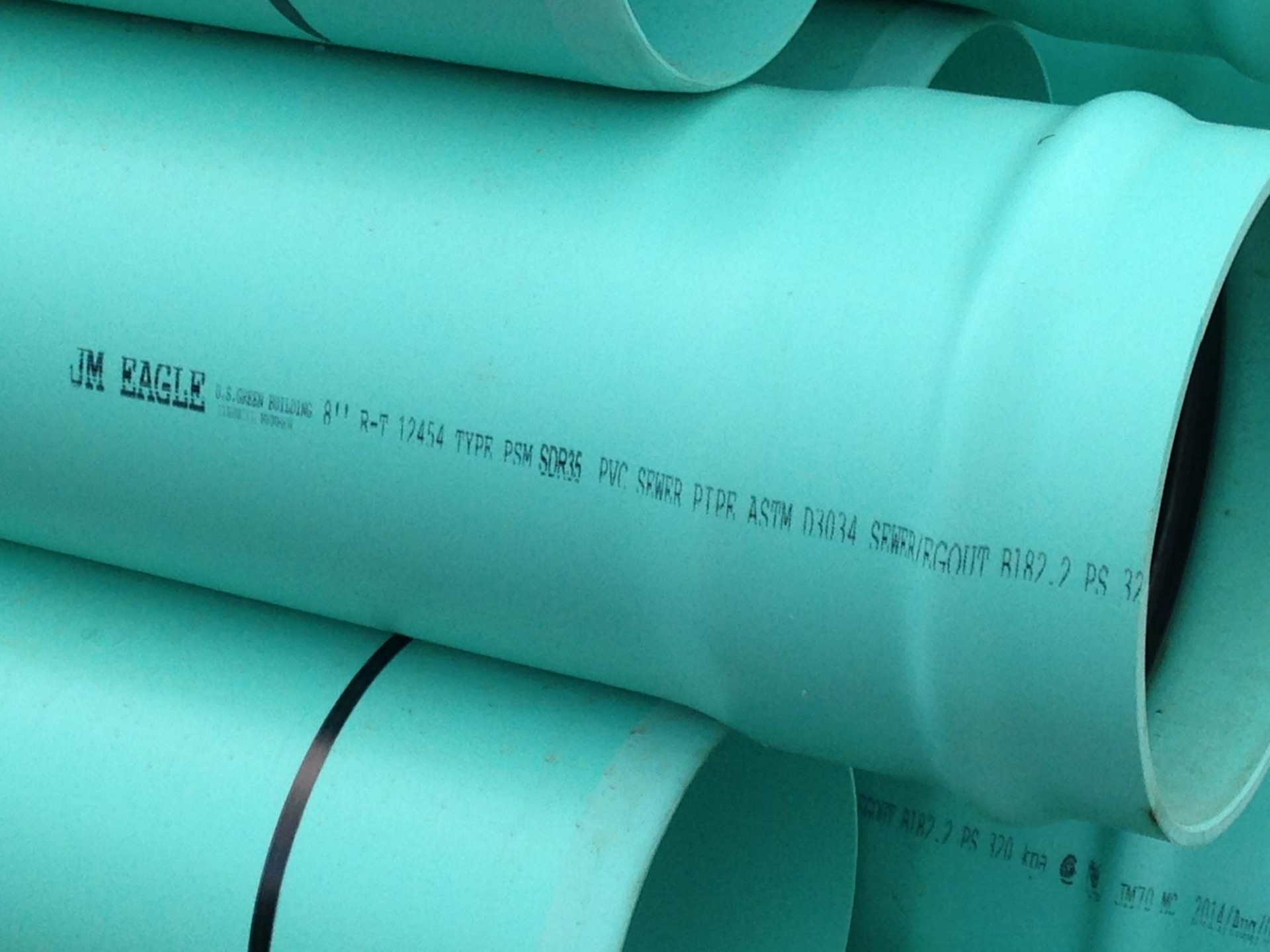
1 PARAPET AT PASSIVE HOUSE WALL

44.23 | 3" = 1'-0"


DEERE


4" X 24" X 96"
18 PCS


SOUTH COAST
1 & BTR
D. FIR
KD-HT


JM EAGLE
U.S.GREEN BUILDING
8" R-T 12454 TYPE PSM SDR35 PVC SEWER PIPE ASTM D3034 SEWER/EGOUT B182.2 PS 32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June 25, 2014

Masons Supply Co.
PO Box 42367
Portland, OR 97242

To Whom it May Concern:

The material shipped to Orenco Orchards, C/O RDF Builders Co at NW 231st Ave & Cherry Drive in Hillsboro, Oregon on Sales Order numbers 100971 and 100992 meets the specifications for EPS 29.

Sincerely,

Jim Bartholome, President

Mike Steffen

From: Marty Houston
Sent: Wednesday, June 25, 2014 5:04 PM
To: Jeremy Brooks; Jay Nees; Mike Steffen
Subject: RE: Orenco Orchards

Not to be alarmist, but EPS 29 and Type IX have different characteristics. And EPS29 was not what was specified, Type IX was. We should discuss at your earliest convenience.

EPS Geofoam Properties

Property		ASTM D6817						
		EPS12 Type XI	EPS15 Type I	EPS19 Type VIII	EPS22 Type II	EPS29 Type IX	EPS39 Type XIV	EPS46
Density[1], min.	lb/ft^3 (kg/m^3)	0.70 (11.2)	0.90 (14.4)	1.15 (18.4)	1.35 (21.6)	1.80 (28.8)	2.40 (38.4)	2.85 (45.7)
Compressive Resistance[1] @ 10% deformation, min.	psi psf (kPa)	5.8 840 (40)	10.2 1470 (70)	16.0 2300 (110)	19.6 2820 (135)	29.0 4180 (200)	40.0 5760 (276)	50.0 7200 (345)
Compressive Resistance[1] @ 5% deformation, min.	psi psf (kPa)	5.1 730 (35)	8.0 1150 (55)	13.1 1890 (90)	16.7 2400 (115)	24.7 3560 (170)	35.0 5040 (241)	43.5 6260 (300)
Compressive Resistance[1] @ 1% deformation, min.	psi psf (kPa)	2.2 320 (15)	3.6 520 (25)	5.8 840 (40)	7.3 1050 (50)	10.9 1570 (75)	15 2160 (103)	18.6 2680 (128)
Elastic Modulus[1], min	psi (kPa)	220 (1500)	360 (2500)	580 (4000)	730 (5000)	1090 (7500)	1500 (10300)	1860 (12800)
Flexural Strength[1], min	psi (kPa)	10.0 (69)	25.0 (172)	30.0 (207)	40.0 (276)	50.0 (345)	60.0 (414)	75.0 (517)
Water Absorption[1] by total immersion, max.,	volume %	4.0	4.0	3.0	3.0	2.0	2.0	2.0
Oxygen Index[1], min.	volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Bouyancy Force	lb/ft^3 (kg/m^3)	61.7 (990)	61.5 (980)	61.3 (980)	61.1 (980)	60.6 (970)	60.0 (960)	59.5 (950)

[1] See ASTM D6817 Stamdard for test methods and complete information


4X24X96

From: Jay Hathaway [mailto:jhathaway@carlsontesting.com]
Sent: Friday, June 27, 2014 5:10 PM
To: Marty Houston
Cc: Mark Carter
Subject: RE: Orenco station Foam Compression testing

Thanks. The preliminary summary of results below for the 4x4x4 inch cubes:

Sample	ASTM D1622, Unit Wt. pcf	Average, pcf	13% Displacement Load, lb	Area, in2	ASTM D1621, psi
1A	1.64	1.65	405	16.07	25.2
1B	1.65				
2A	1.92	2.10	490	15.94	30.7
2B	2.28				
3A	1.52	1.52	410	15.75	26.0
3B	1.52				
4A	2.12	2.13	550	15.30	35.9
4B	2.14				
5A	1.69	1.73	376	15.62	24.1
5B	1.77				
	Average	1.83		Average	28.4

Jay Hathaway, P.E.
Senior Engineer
Carlson Testing, Inc. Office: 503-684-3460
8430 S.W. Hunziker Direct: 503-419-4547
P.O. Box 23814 Cell: 503-318-2763
Tigard, Oregon 97281 Fax: 503-684-0954
www.carlsontesting.com

Mike Steffen

From: Scott Nyseth [scott.nyseth@stonewoodstructural.com]
Sent: Thursday, July 03, 2014 6:50 AM
To: Craig Kelley; Jay Nees; 'Amanda Asa'; 'Michael Bonn'
Cc: Marty Houston; Mike Steffen; Jeremy Brooks; Travis Moore; 'Jessica Woodruff'
Subject: RE: Orenco station Foam Compression testing

Hi Craig,

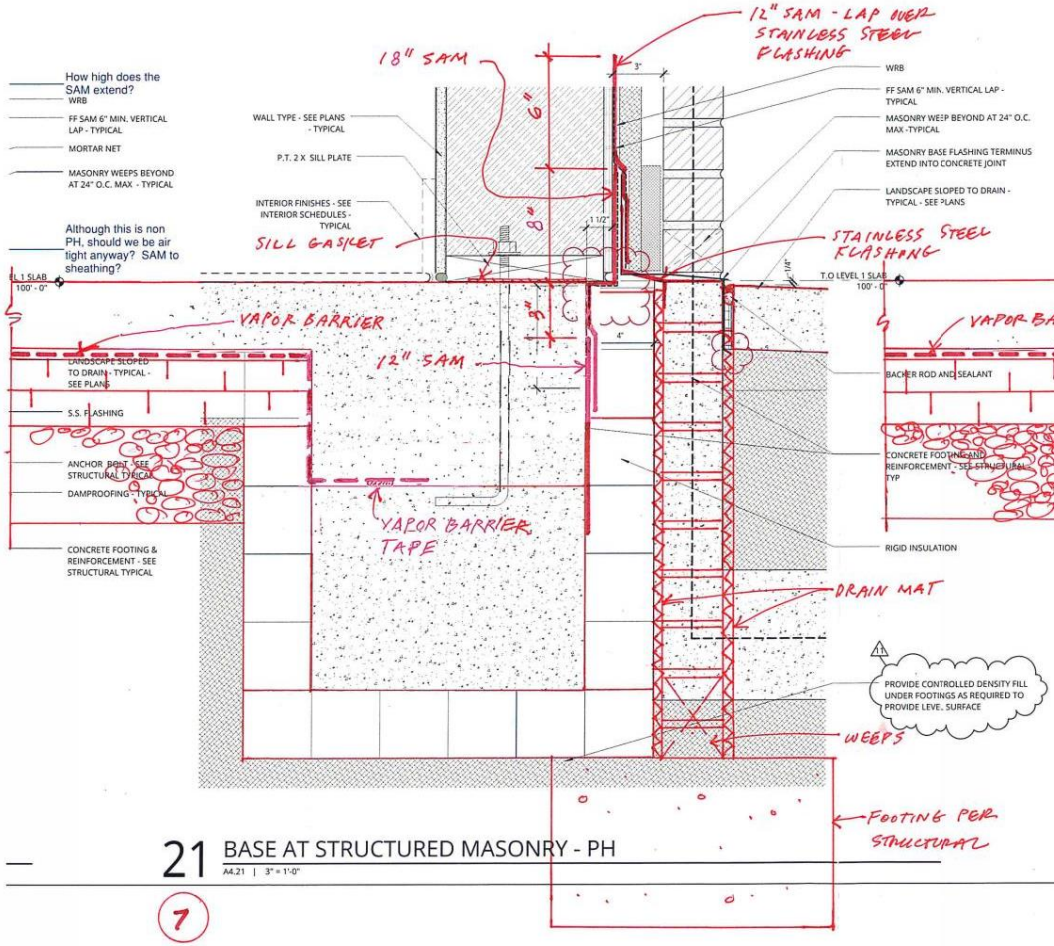
1/16" additional settlement is what the #'s say based on the testing that Carlson did, which was on a limited # of tests. For prudence, we should assume 1/8" additional and plan for this. Exterior hardscape should be placed accordingly at threshholds. Also, provision for any hard piping coming up through the slab on grade at any point should be able to handle some movement with respect to the adjacent slab on grade.

This deflection is not a structural concern. The wood framing and concrete has sufficient ductility and robustness to handle this settlement.

Scott

STONEWOOD

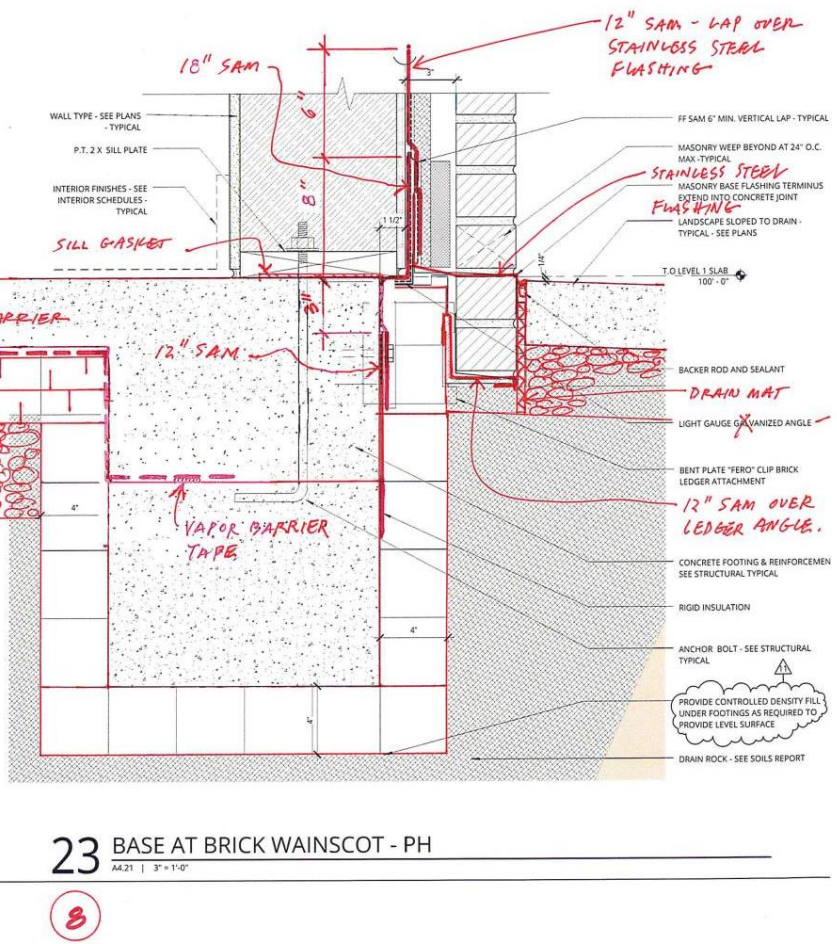
D. Scott Nyseth - S.E.- President
Stonewood Structural Engineers, Inc.
4600 NW Camas Meadows Drive Suite 205
Camas, Washington 98607
360.953.1545



21 BASE AT STRUCTURED MASONRY - PH

A4.21 | 3" = 1'-0"

7



23 BASE AT BRICK WAINSCOT - PH

A4.21 | 3" = 1'-0"

8

FOUNDATION COORDINATION DRAWINGS

7/29/2014.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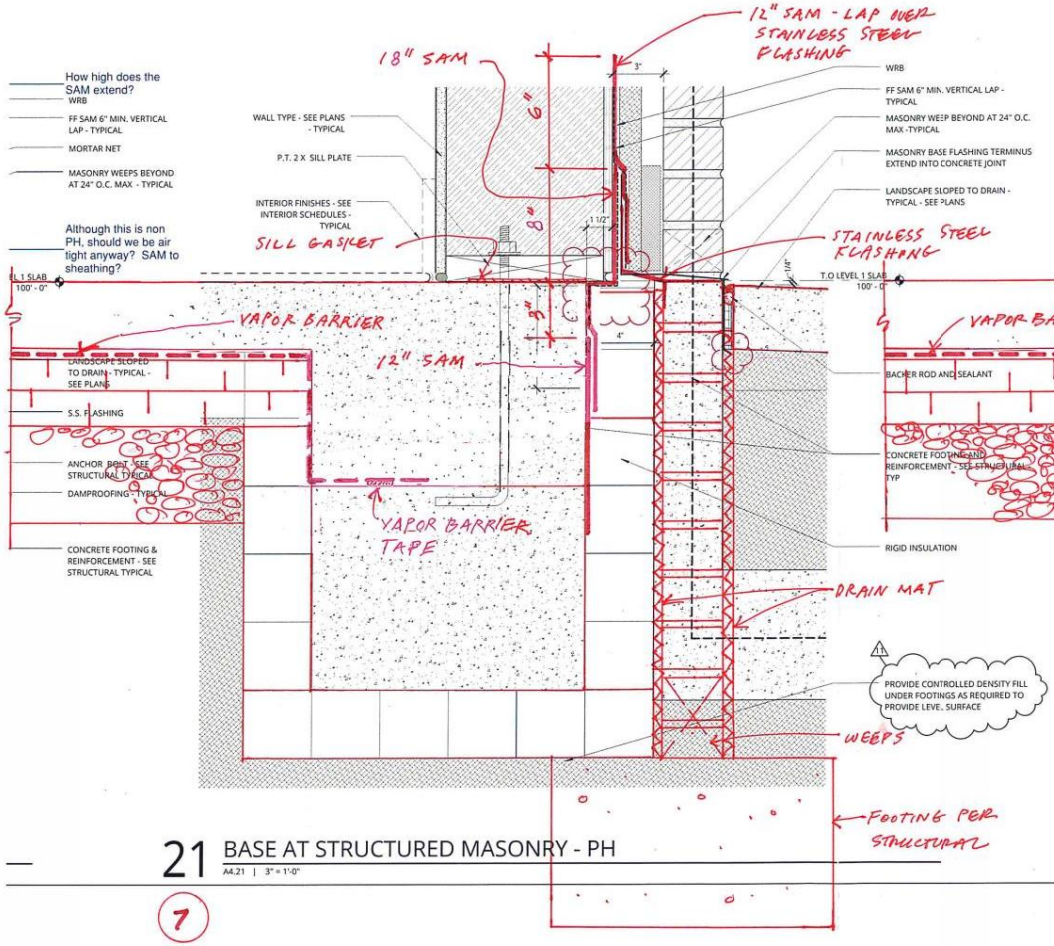
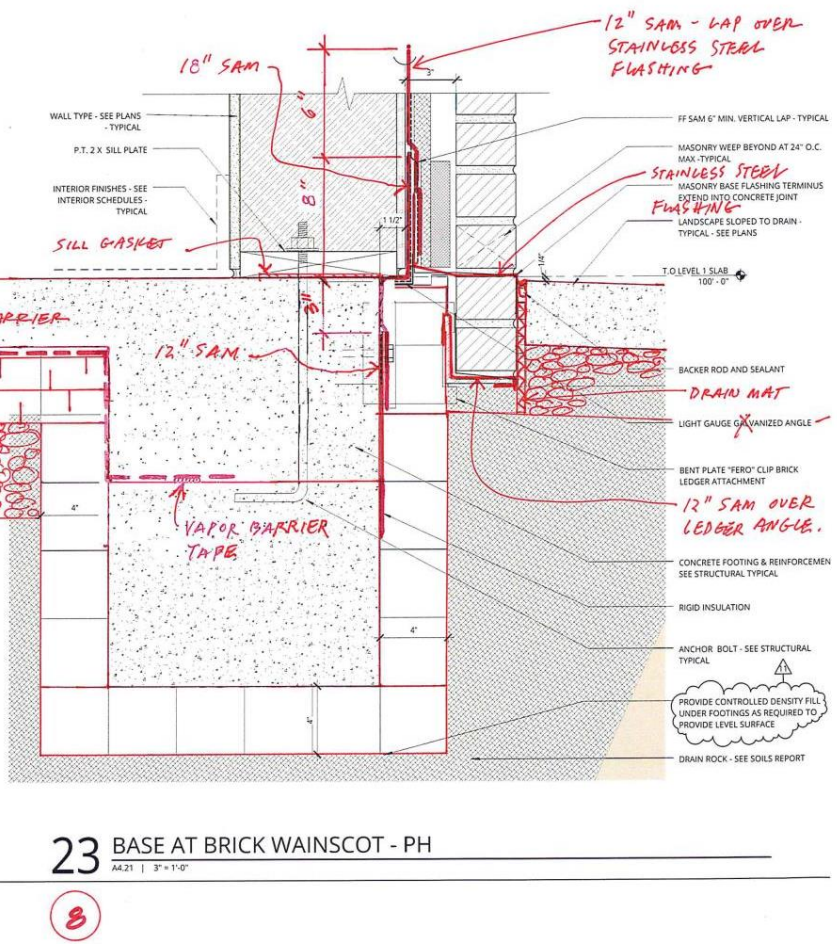


21 BASE AT STRUCTURED MASONRY - PH

A4.21 | 3" = 1'-0"

7



23 BASE AT BRICK WAINSCOT - PH

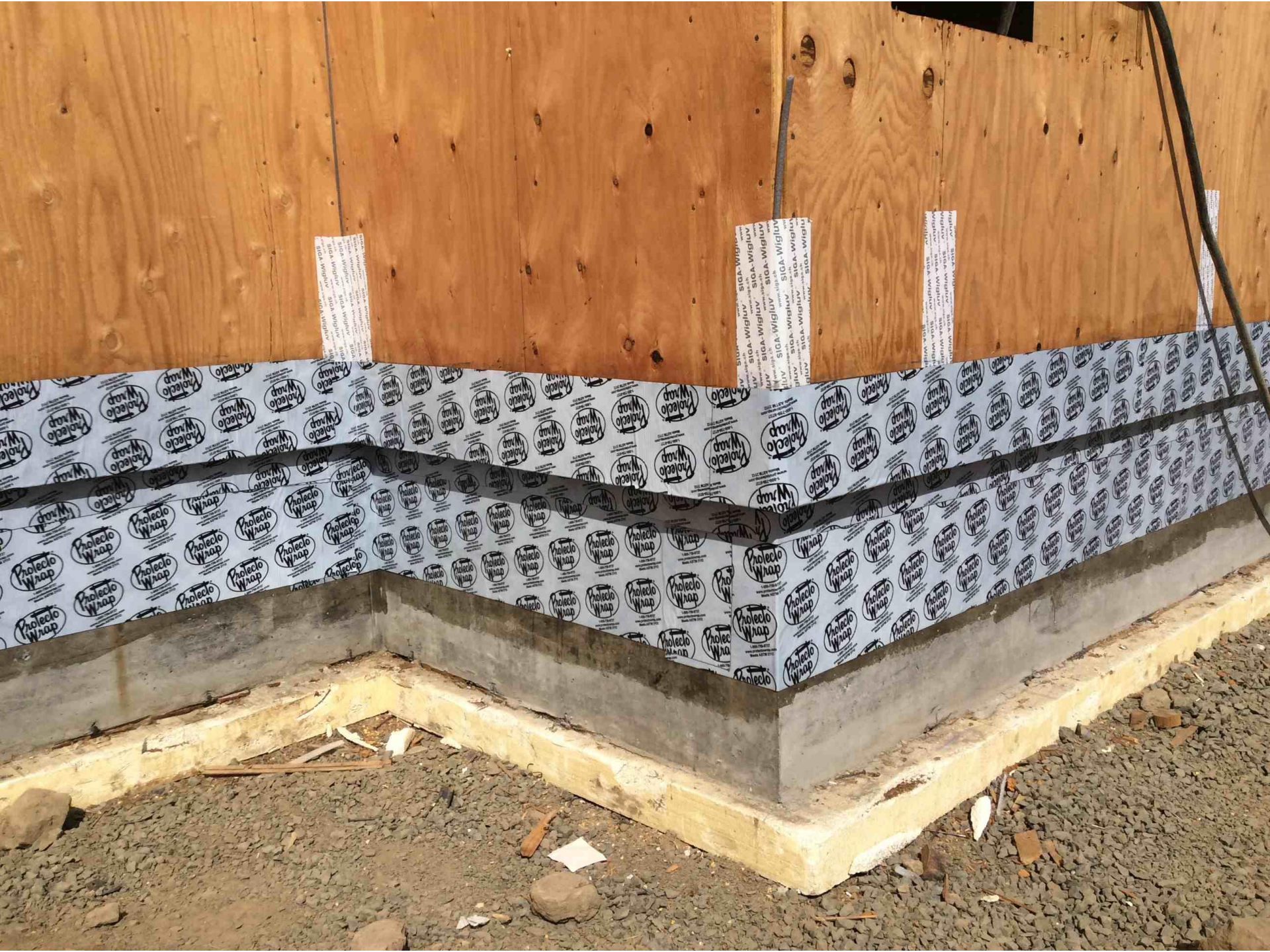
A4.21 | 3" = 1'-0"

8

FOUNDATION COORDINATION DRAWINGS

7/29/2014.


SW 231st Ave
TIMBERLAND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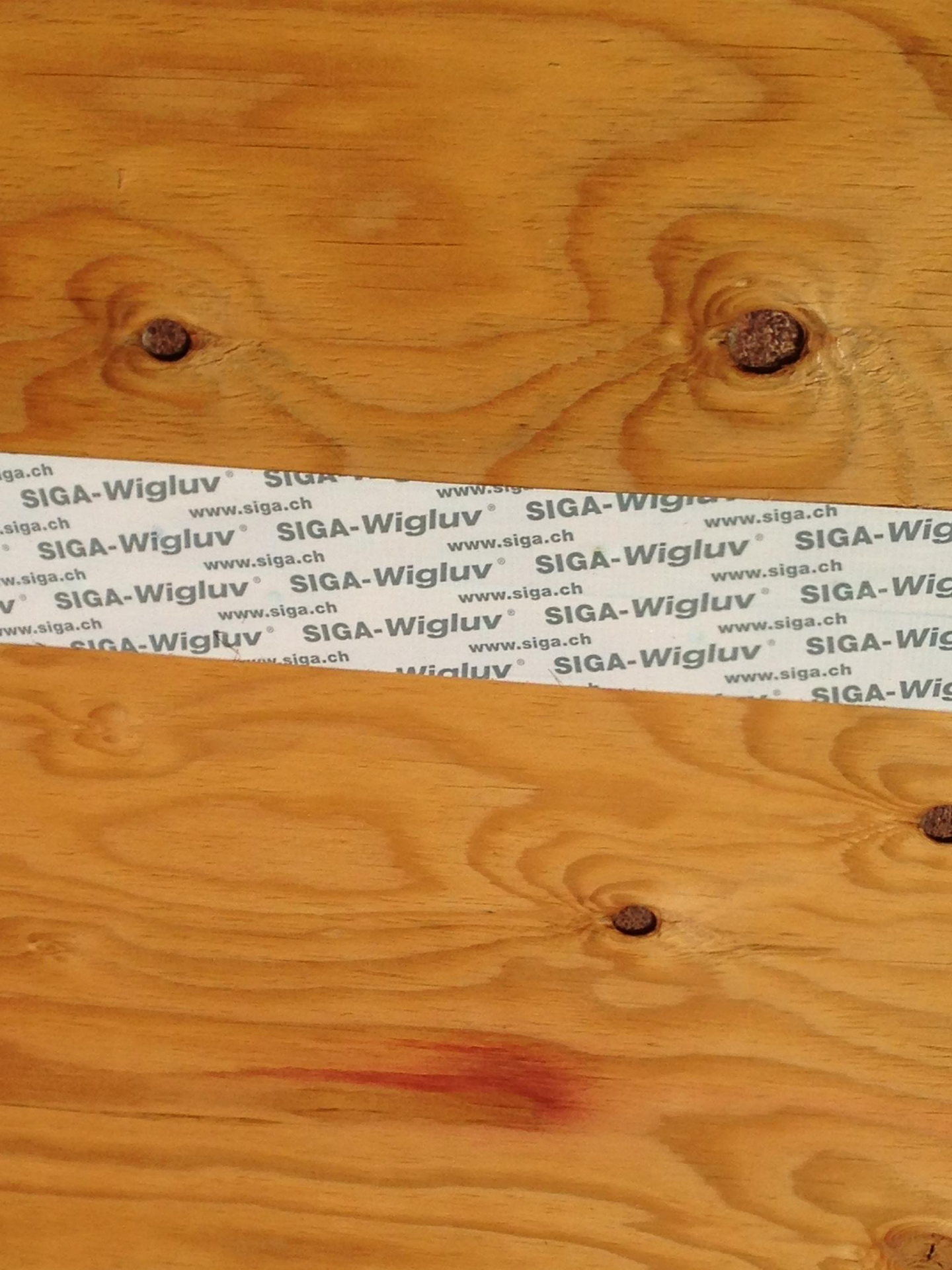
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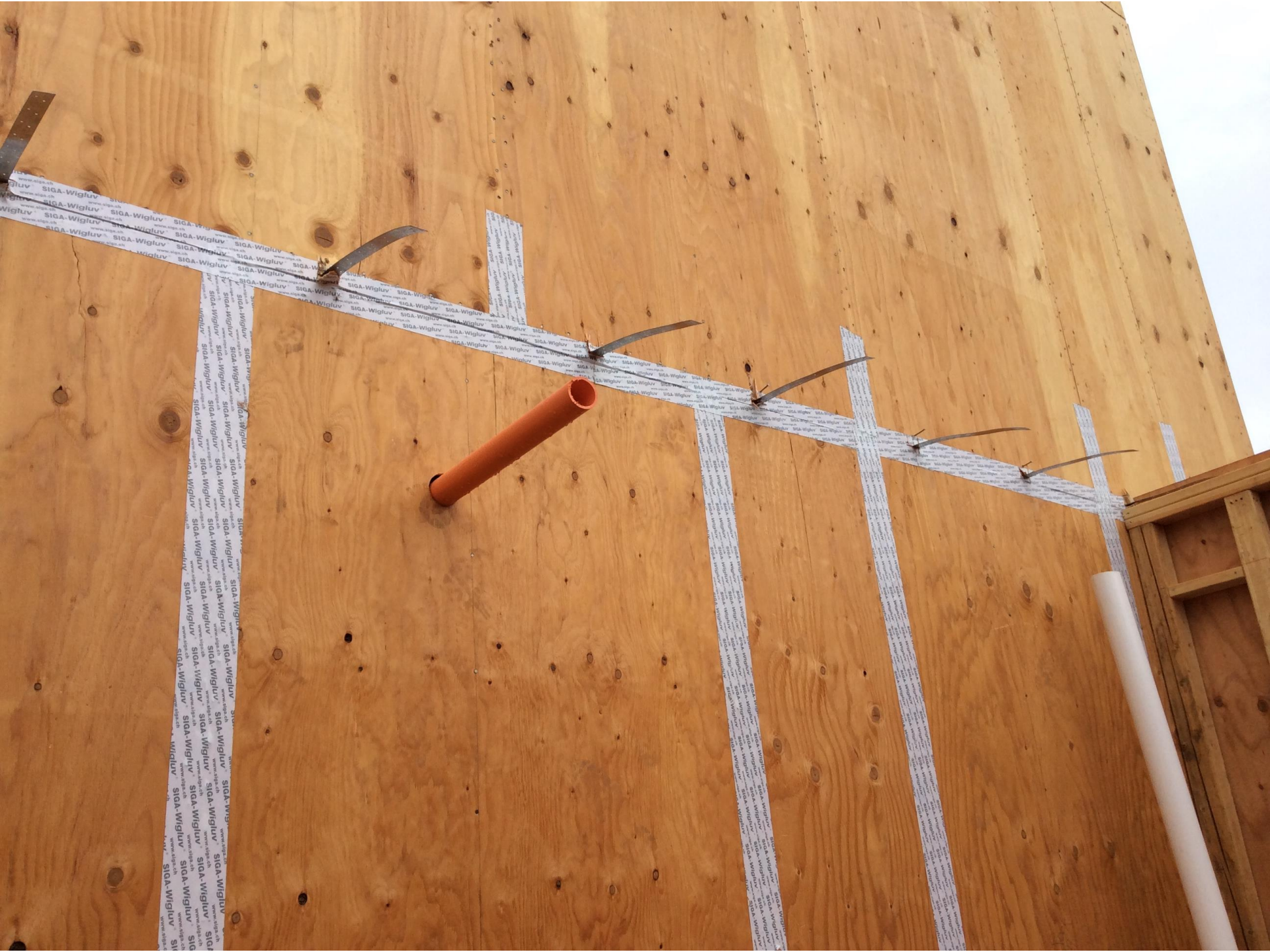
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Orchards at Orenco R1A
Location or Type
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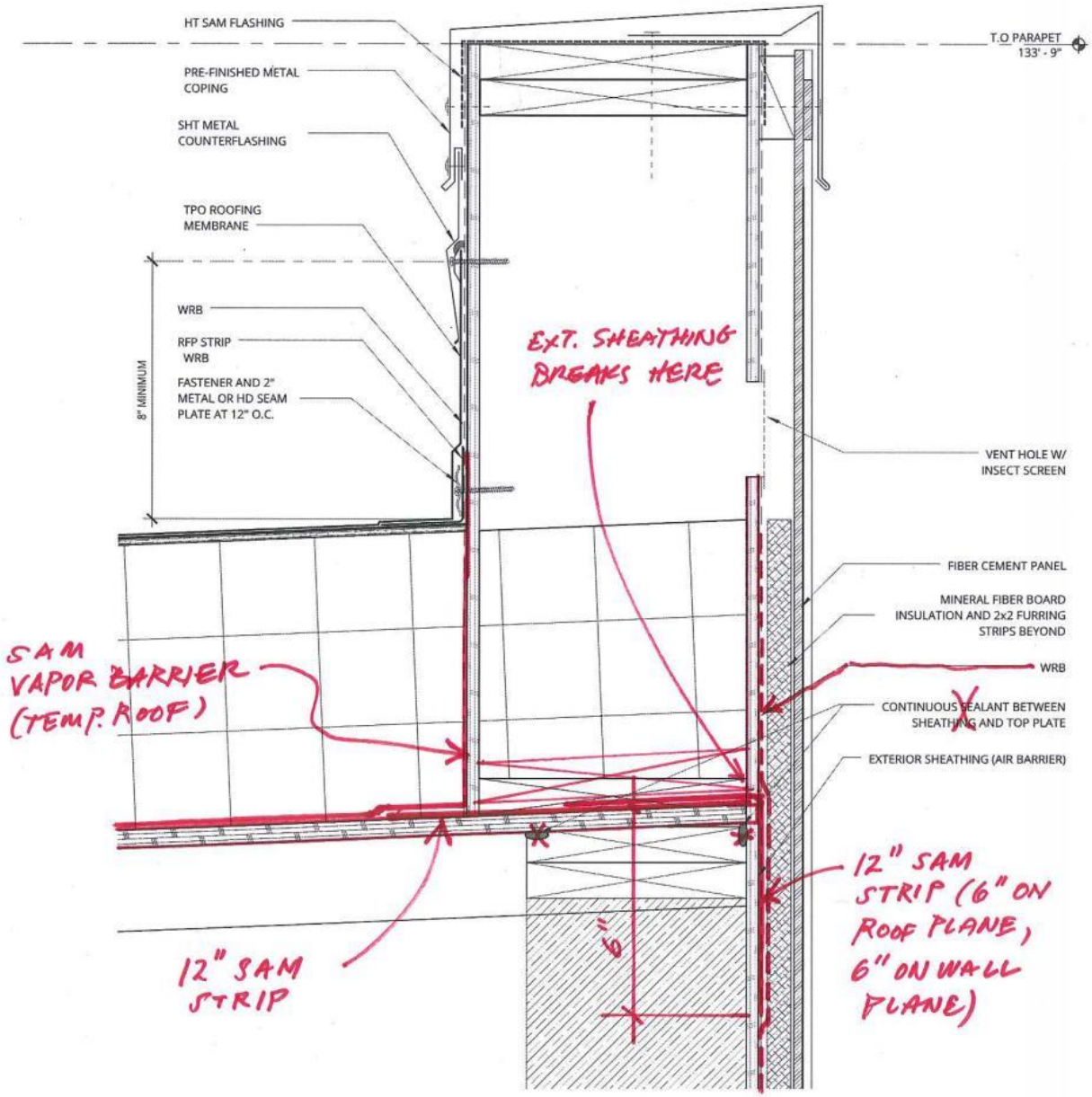
Item No.: 8
PFG
28"1/8 x 46"1/8
EUROLINE WINDOWS


Tyvek



1 PARAPET AT PASSIVE HOUSE WALL

44.23 | 3" = 1'-0"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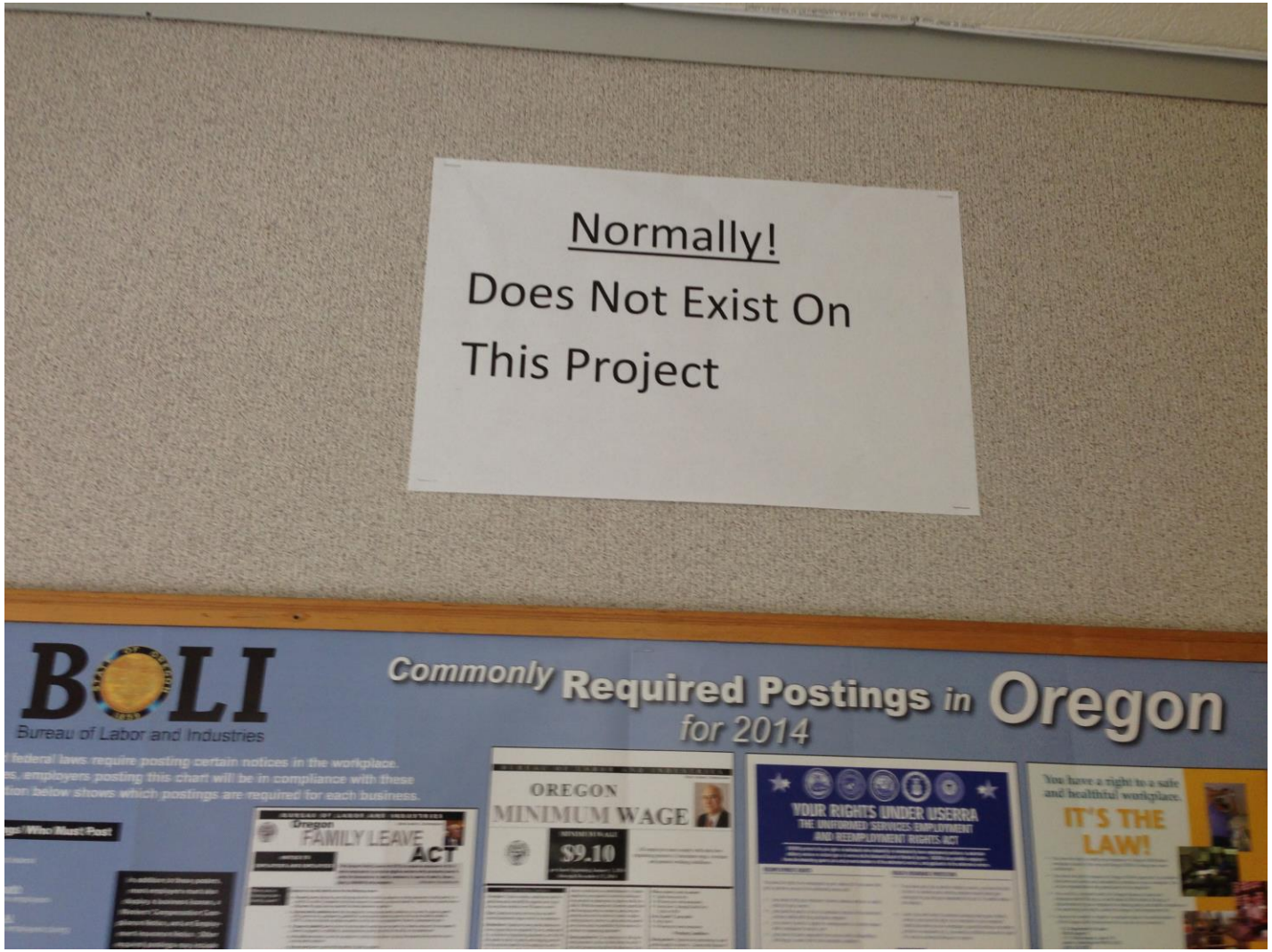
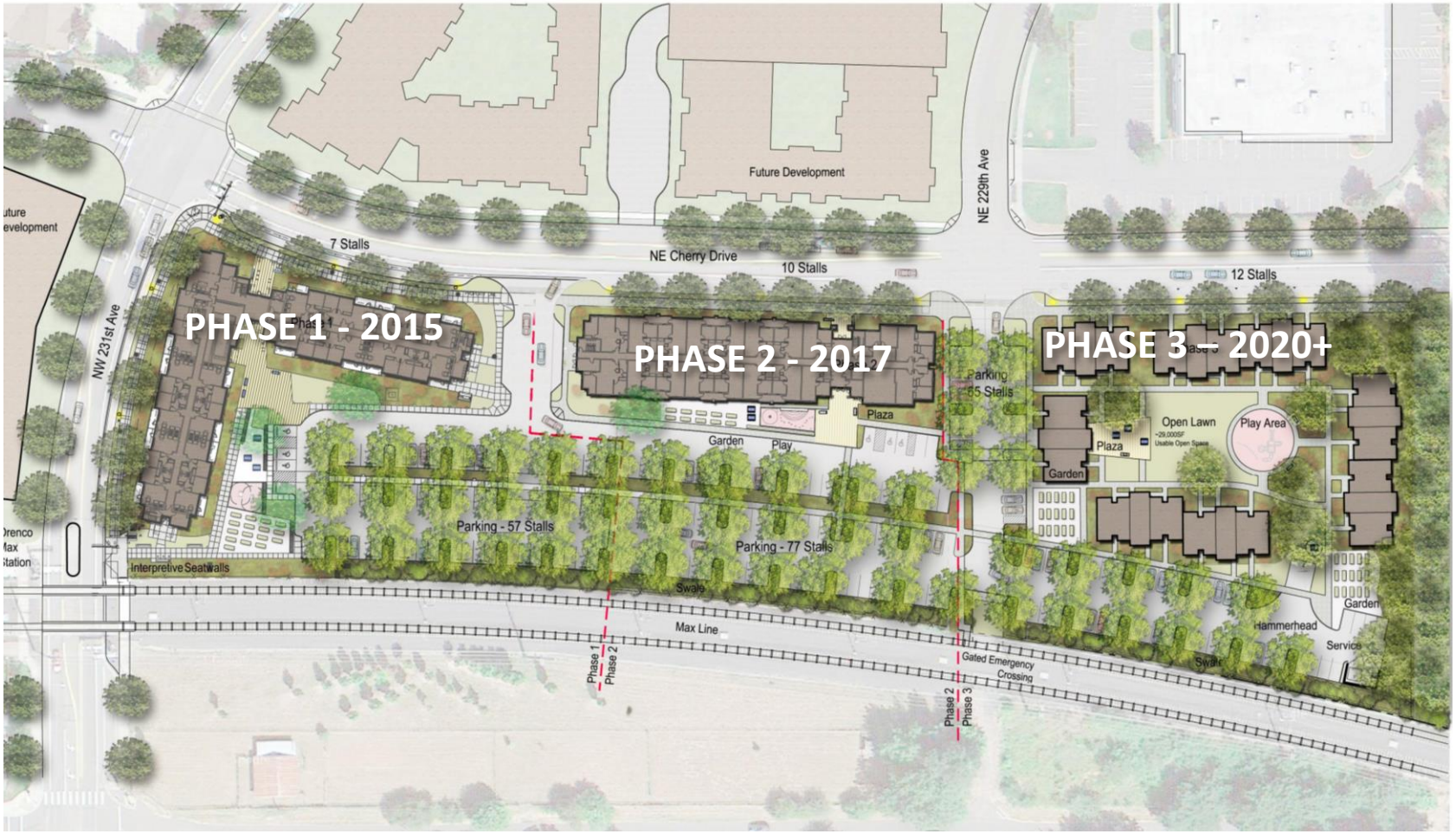
Conclusions

- Would we do it again?
  - Ankrom Moisan Architects – Yes
  - REACH – Maybe
- The PH cost premium for this project in our area, climate, and construction type is 11% ($161/sf)
- Biggest challenges
  - Lack of PH Certified building components. Doors, Windows, HVAC equipment. The hit to the PHPP model hurts.
  - Challenges of designing new, innovative detailing around thermal bridging and airtightness were costly for the design team.
- A motivated, integrated team approach with all parties “drinking the Kool-Aid” is essential.
  - ‘Normally’ does not exist.

Lessons Learned

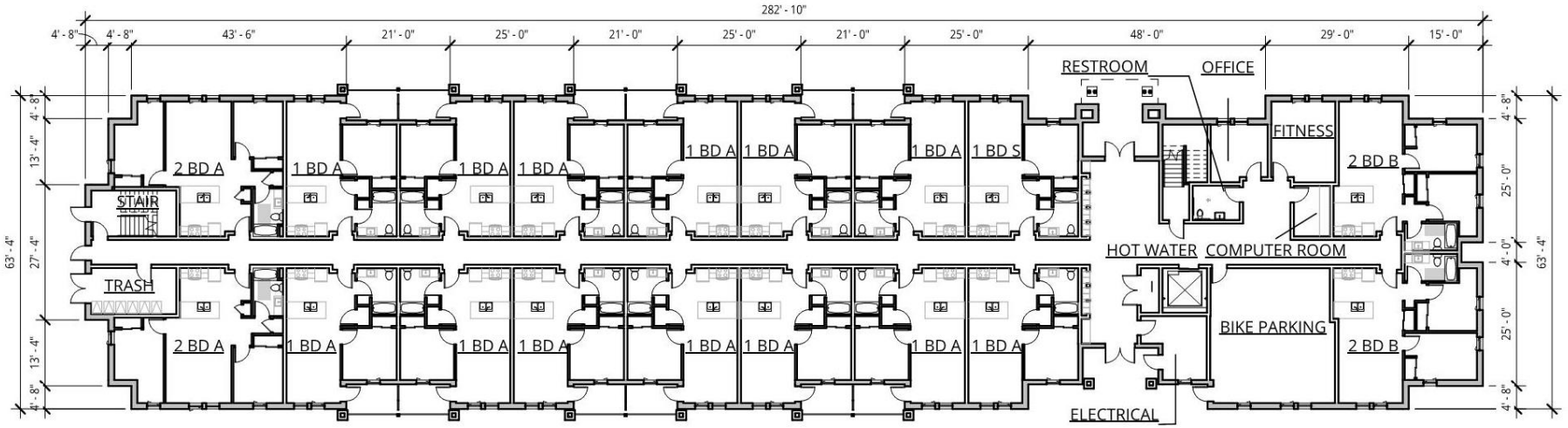


Phase II

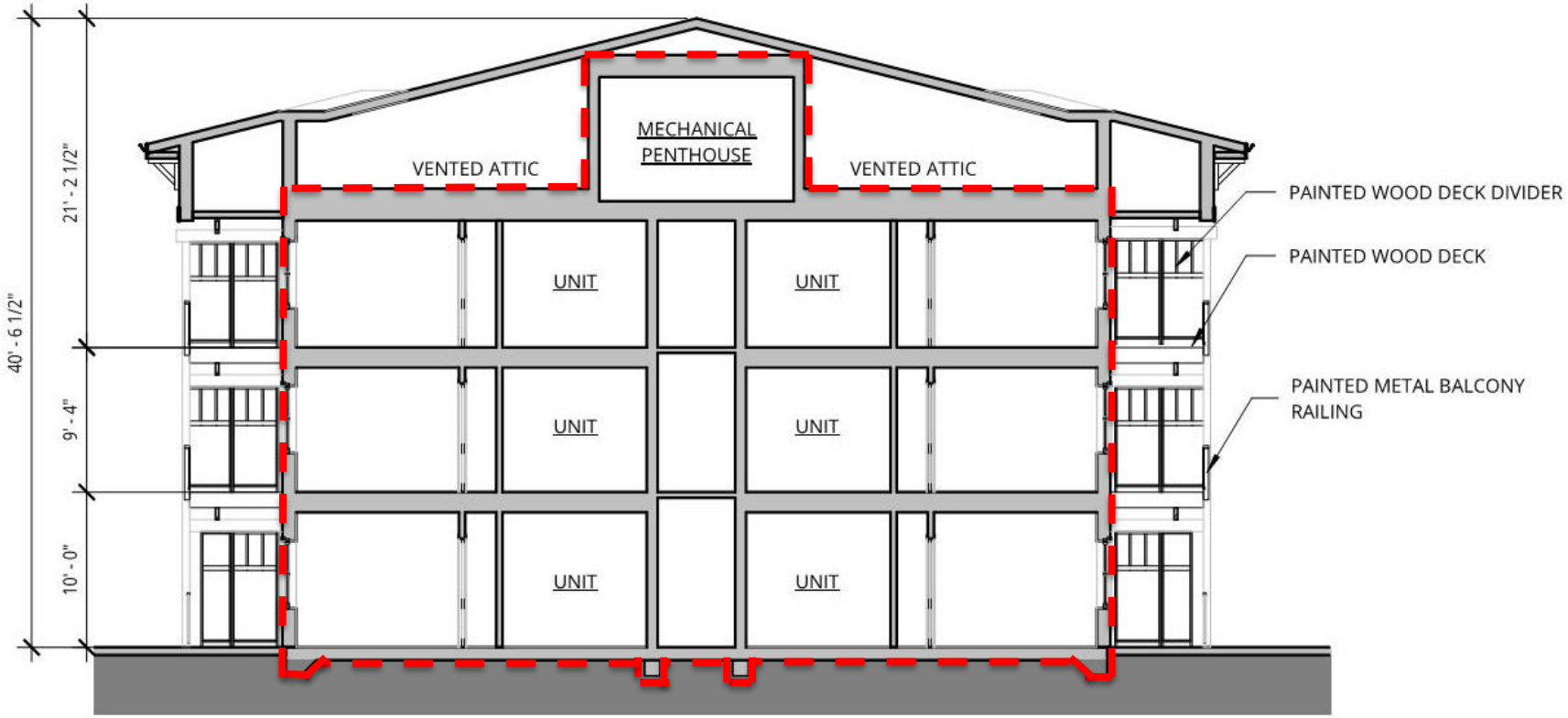

PHASE 1 - 2015
PHASE 2 - 2017
PHASE 3 – 2020+
Future Development
NE 229th Ave
NE Cherry Drive
7 Stalls
10 Stalls
12 Stalls
NW 231st Ave
Parking
85 Stalls
Plaza
Garden
Play
Open Lawn
Play Area
Parking - 57 Stalls
Parking - 77 Stalls
Interpretive Seatwalls
Swale
Max Line
Hammerhead
Services
Garden
Gated Emergency
Crossing
Phase 1
Phase 2
Phase 2
Phase 3

Phase II

Phase II


282' - 10"
4' - 8"
4' - 8"
43' - 6"
21' - 0"
25' - 0"
21' - 0"
25' - 0"
21' - 0"
25' - 0"
48' - 0"
29' - 0"
15' - 0"
RESTROOM
OFFICE
FITNESS
2 BD B
2 BD A
1 BD A
1 BD S
STAIR
TRASH
HOT WATER
COMPUTER ROOM
BIKE PARKING
ELECTRICAL
63' - 4"
13' - 4"
27' - 4"
25' - 0"

Phase II


40' - 6 1/2"
21' - 2 1/2"
9' - 4"
10' - 0"
VENTED ATTIC
MECHANICAL PENTHOUSE
VENTED ATTIC
UNIT
UNIT
UNIT
UNIT
UNIT
UNIT
PAINTED WOOD DECK DIVIDER
PAINTED WOOD DECK
PAINTED METAL BALCONY RAILING