Orchards at Orenco: Phase I vs. Phase II

More Units…Less Cost…Still Passive

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Woodworks
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Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

Outline

- Orchards at Orenco – Background & Context
- Orchards Ph. I vs. Orchards Ph. II
  - Design
  - Passive House Process
  - Construction
  - Feedback / Monitoring / Measured Performance
  - Challenges and Lessons Learned
  - Costs
- Orchards at Orenco – Proof of Concept?

Learning Objectives

- Demonstrate how the Passive House standard has been applied successfully to affordable housing development, serving as a model for future developments in North America, and serving as a primary path to achieving net zero energy affordable housing
- Describe the key design measures incorporated in the overall building design, enclosure and mechanical systems to achieve Passive House certification
- Describe the integrated teamwork / process used by the project team in the design, construction and operation of high performance affordable housing
- Demonstrate how efficient design and cost optimization can be used to reduce the overall development and operating costs of affordable housing

The Orchards at Orenco

- Affordable housing community in Hillsboro, OR
  - Phase I: 57 units of workforce housing (completed 6/2015)
  - Phase II: 58 units of workforce housing (completed 7/2016)
  - Phase III: 52 units of family sized workforce housing (completed 2018)

- Developer/Owner:
  REACH Community Development

REACH Community Development

- REACH's goal is to provide **Healthy**, **Safe** and **Affordable** living

- Affordability not only includes low rents but also close proximity to work and schools, and low **monthly utility bills**

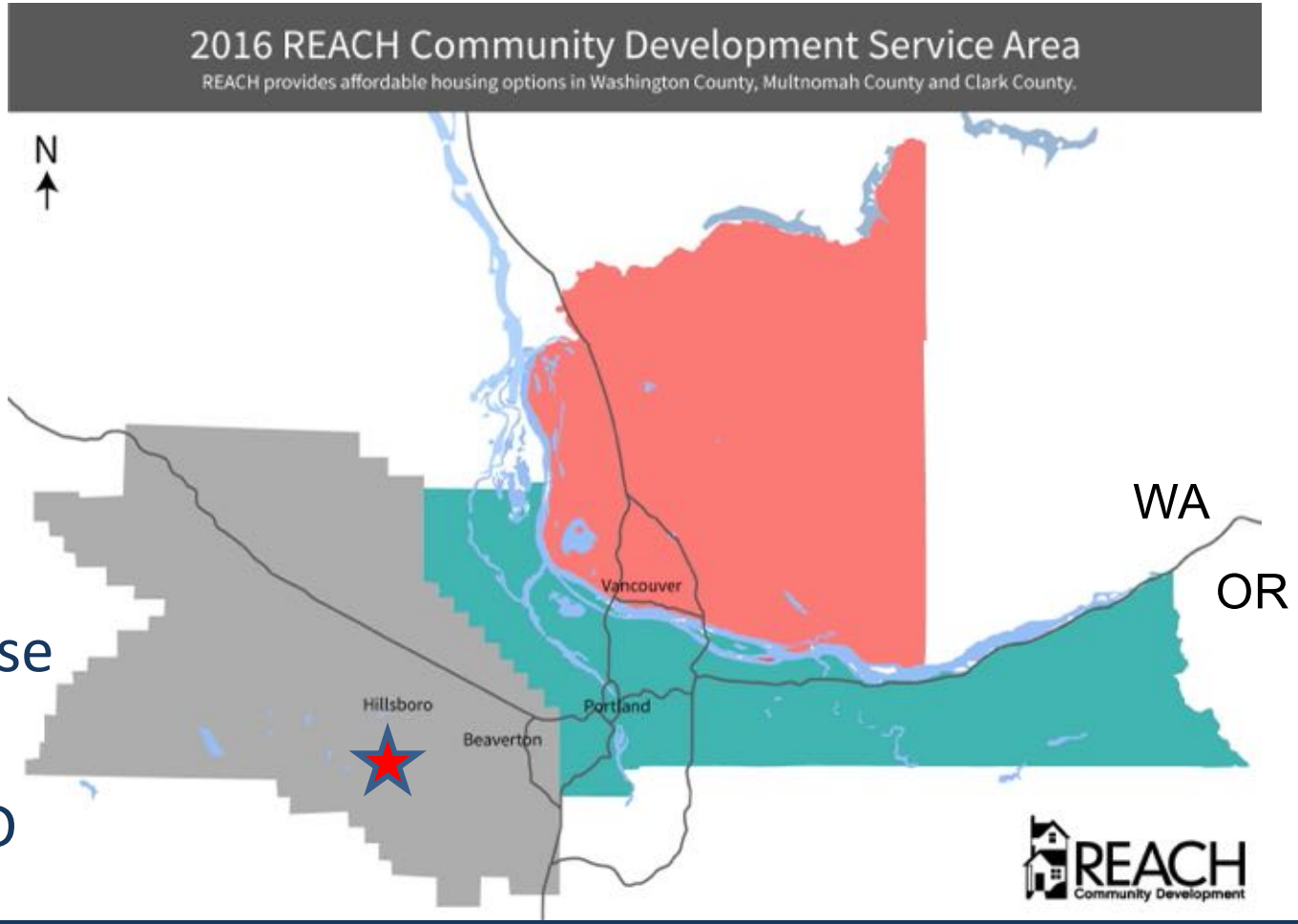
- REACH set a goal in their 2010 Strategic Plan to have a Passive House project in their portfolio by 2015

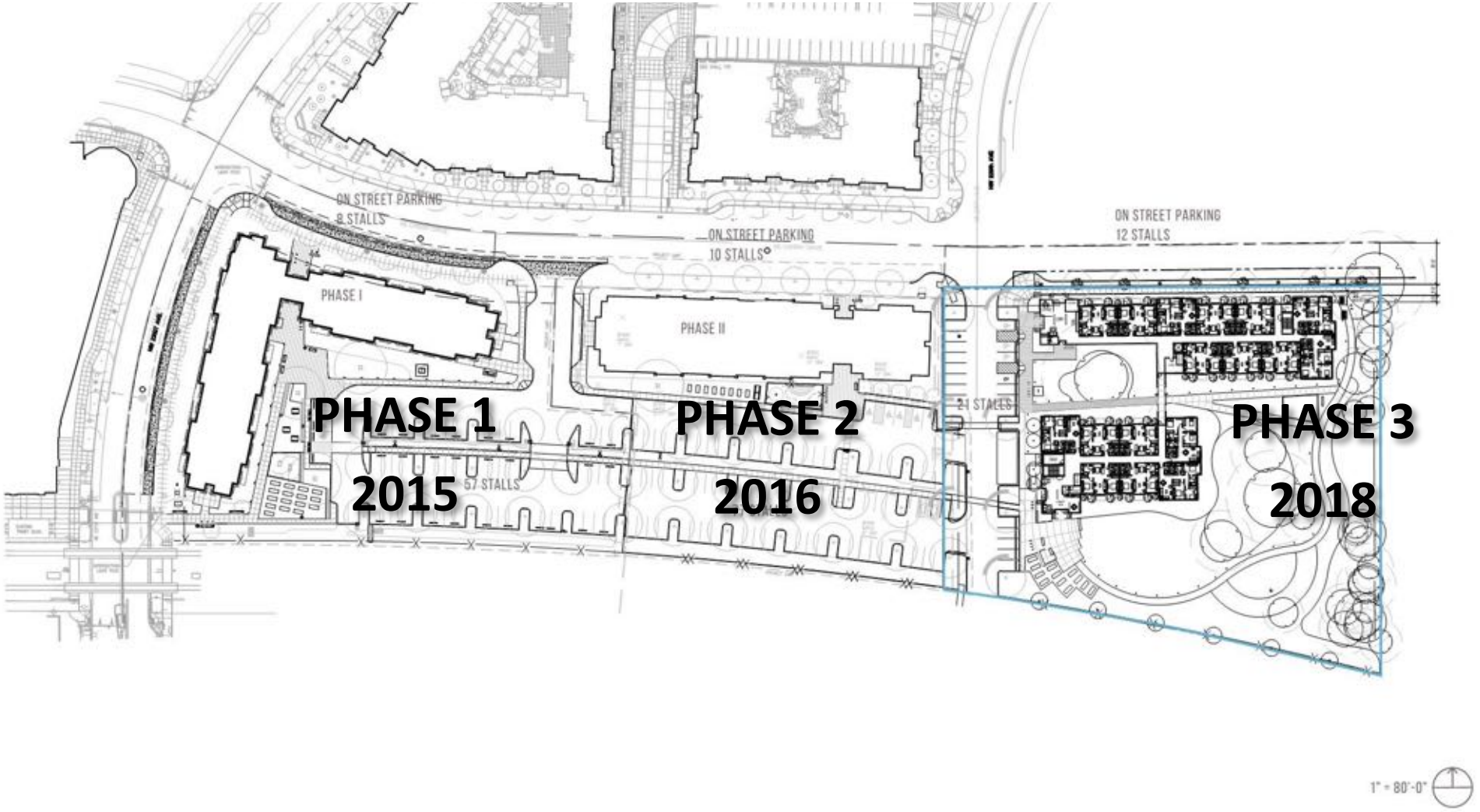
Why Passive House?

- Most rigorous building energy efficiency standard in world
- Achieve significant reductions of utility costs to residents, while improving comfort and durability
- The right path to net zero…

Orchards at Orenco - Background

- Site history
- Suburban location
- Growing community
- High-tech employer base
- Light rail TOD





The Orchards at Orenco

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Phase I Basics

- 57 units of affordable workforce housing
- 57,750 square feet
- 3-story, wood frame construction on concrete slab-on-grade foundation

Design Overview

Photo Credit: Casey Braunger

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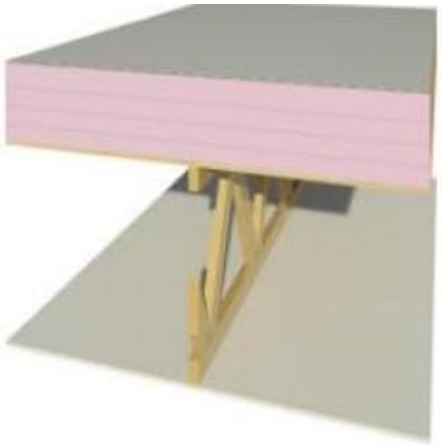
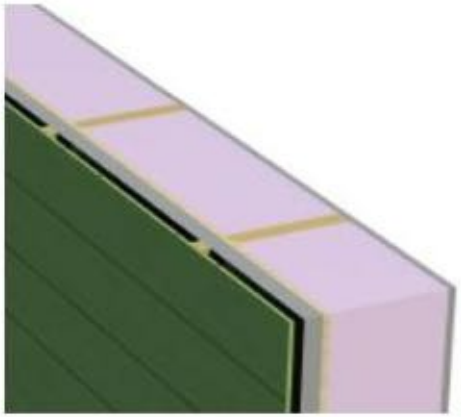
Aerial View from South

First Floor Plan



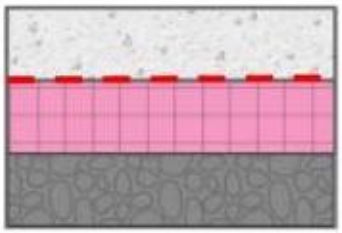
Typical Roof Assembly: R-81

- 80 mil TPO roof membrane (fully adhered, white)
- 1/2" coverboard
- 12" polyisocyanurate insulation
- Self-adhered rubberized asphalt membrane vapor barrier (serves also as temp. roof)
- 3/4" plywood
- Prefabricated wood truss framing (trusses @ 24"o.c.)
- 5/8" gypsum wall board (2 layers)



Typical Exterior Wall Assembly: R-39

- Fiber cement siding w/ treated 1x wood furring @ 24" o.c.
- 1-1/2" rigid mineral wool insulation (8 lb. density)
- Spun-bonded polyolefin sheet water-resistive barrier
- 1/2" plywood with air sealing tape at all seams
- 2x10 wood framing (studs at 24" o.c.)
- 9 1/4" blown fiberglass insulation at all framing cavities
- Polyamide sheet vapor barrier
- 5/8" gypsum wall board



Typical Slab Assembly: R-19

- 4" concrete slab
- 15 mil polymer sheet vapor barrier
- 4" Type II expanded polystyrene insulation
- Gravel base with radon mitigation system piping

Enclosure Assemblies

HVAC Design

Mechanical Penthouse

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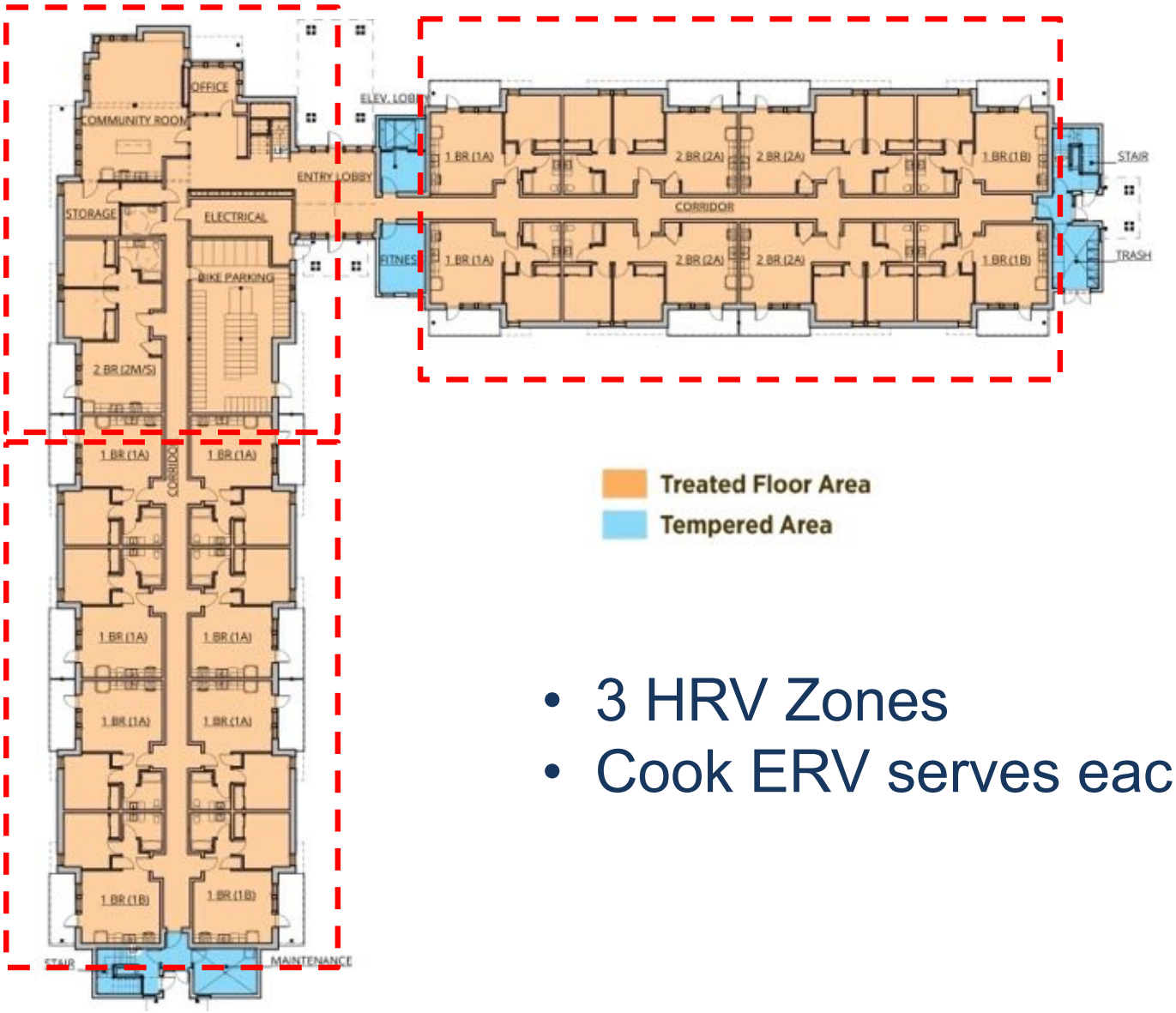
HVAC Design



- 3 HRV Zones
- Cook ERV serves each zone

HVAC Design

- Continuous 50cfm supply air per bedroom
- Continuous exhaust at kitchen and bath
- Electric cove heater in living room for user control & backup heat
  - Estimated at 20% of building heating load
- No active cooling at apartments

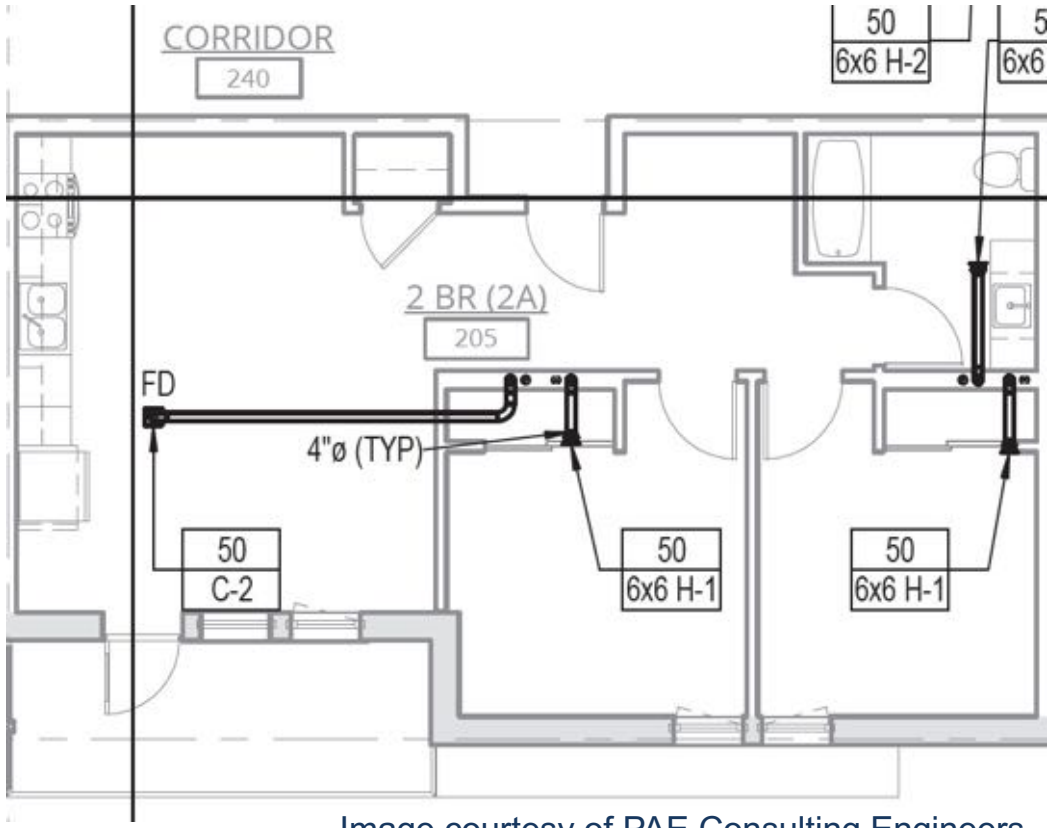


Image courtesy of PAE Consulting Engineers

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Preliminary Airtightness Test Result: 0.0875 ACH_{50}

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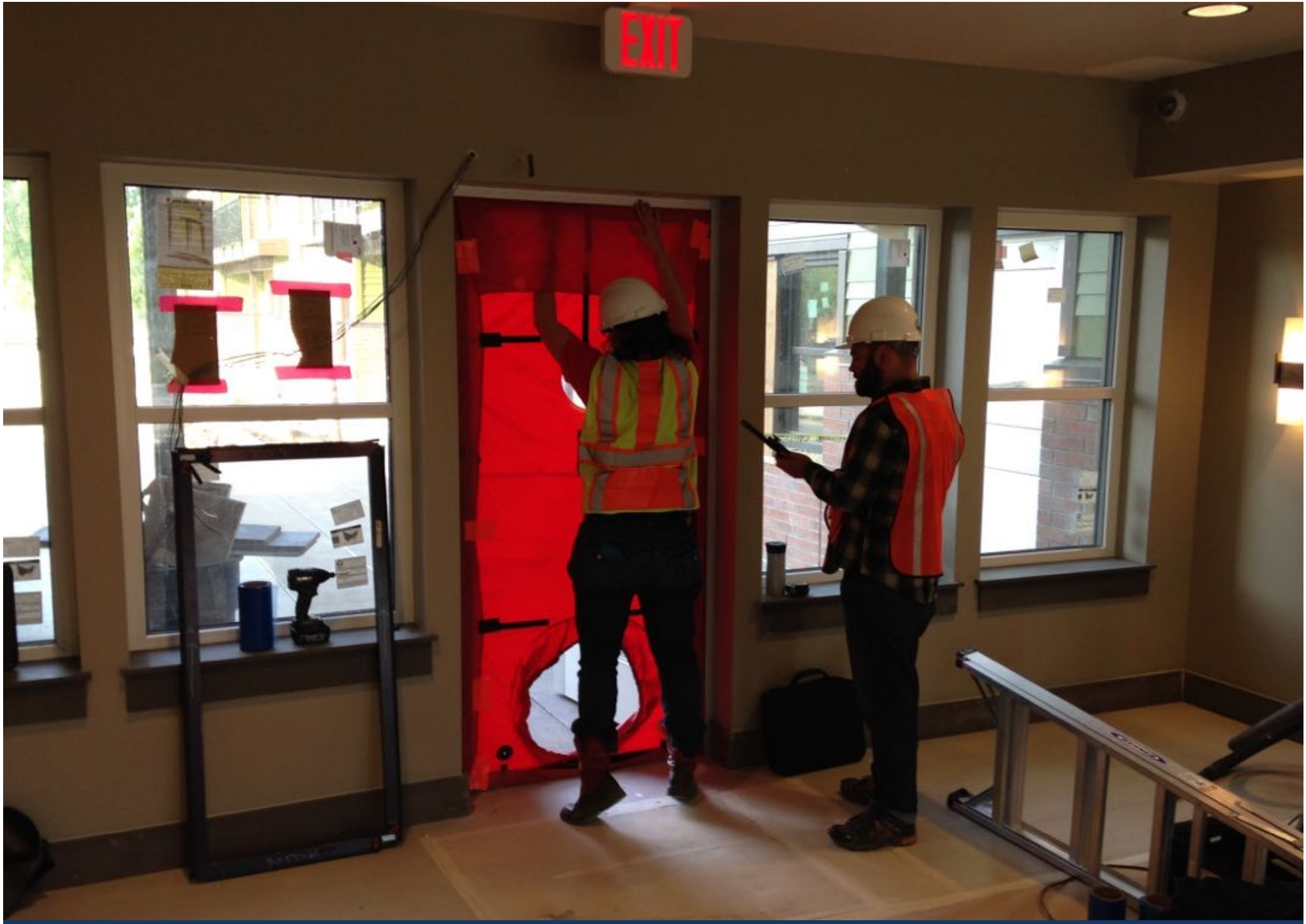

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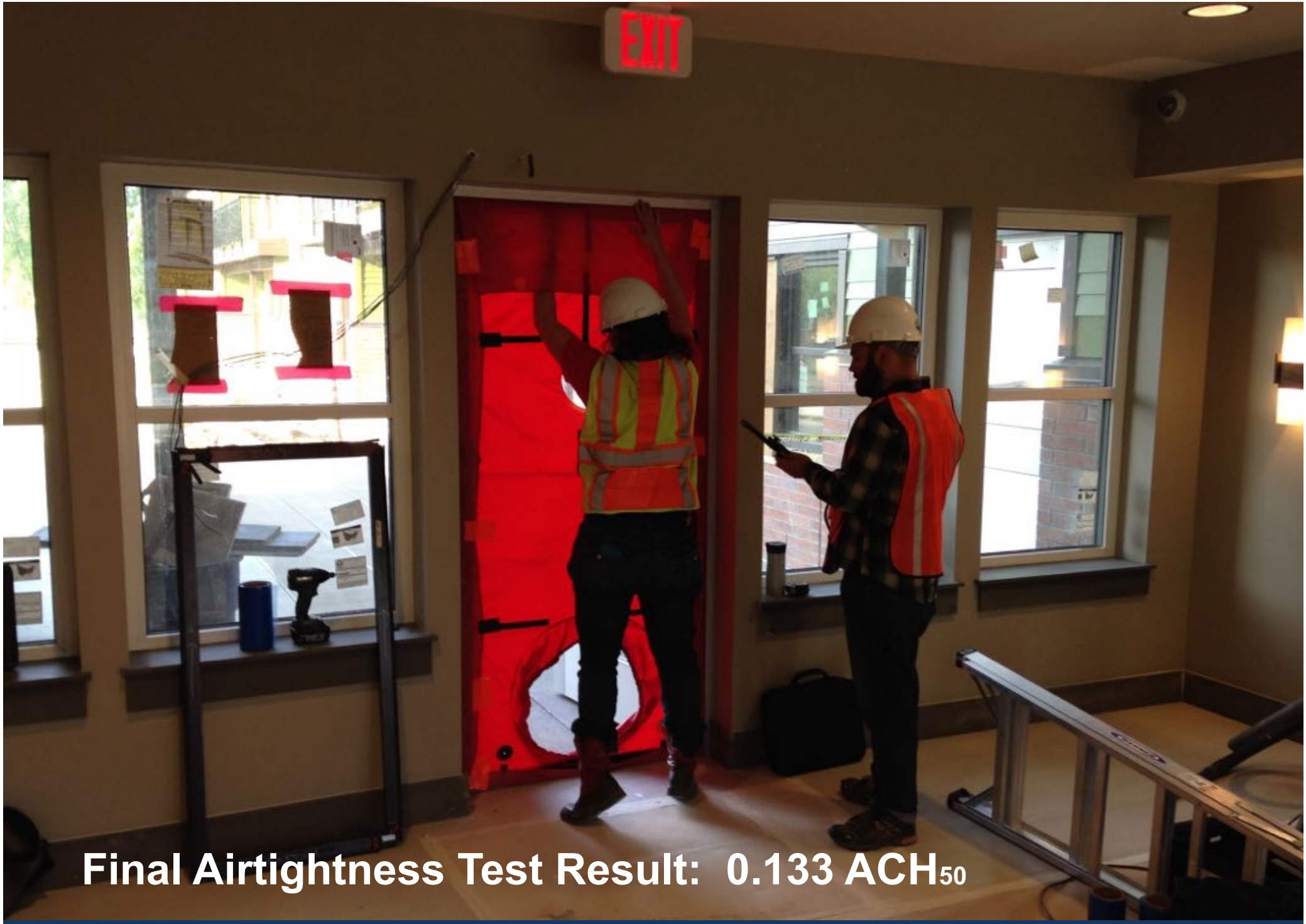

Final Airtightness Test Result: 0.133 ACH_{50}

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Phase I - Lessons Learned

- Owner vision - and commitment - is pivotal

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- It takes a team…working collaboratively, with everyone pulling in the same direction

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- Owner vision - and commitment - is pivotal
- It takes a team…working collaboratively, with everyone pulling in the same direction
- Early team integration pays off
- Proactive coordination and QC is essential
- Keep it simple

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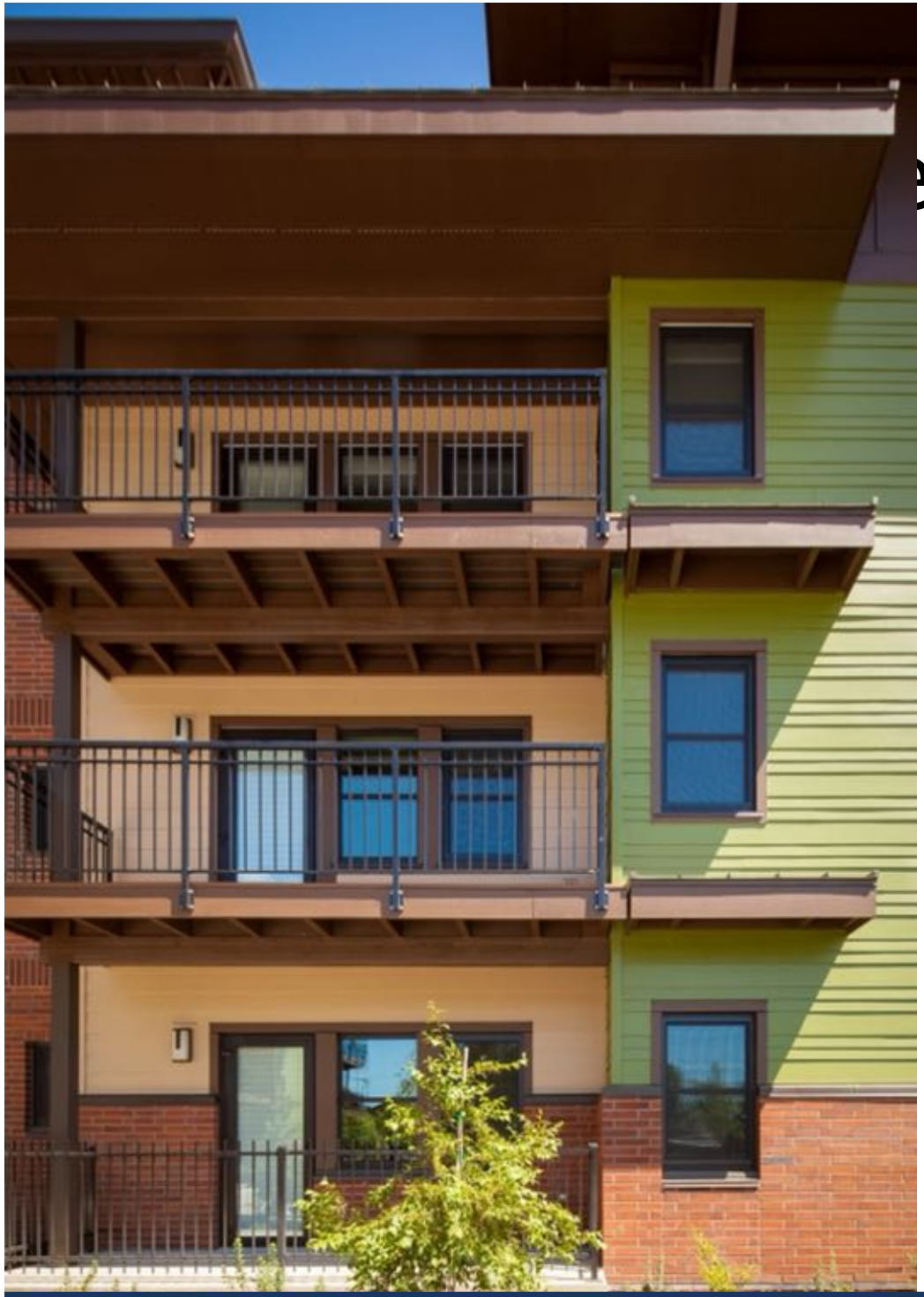

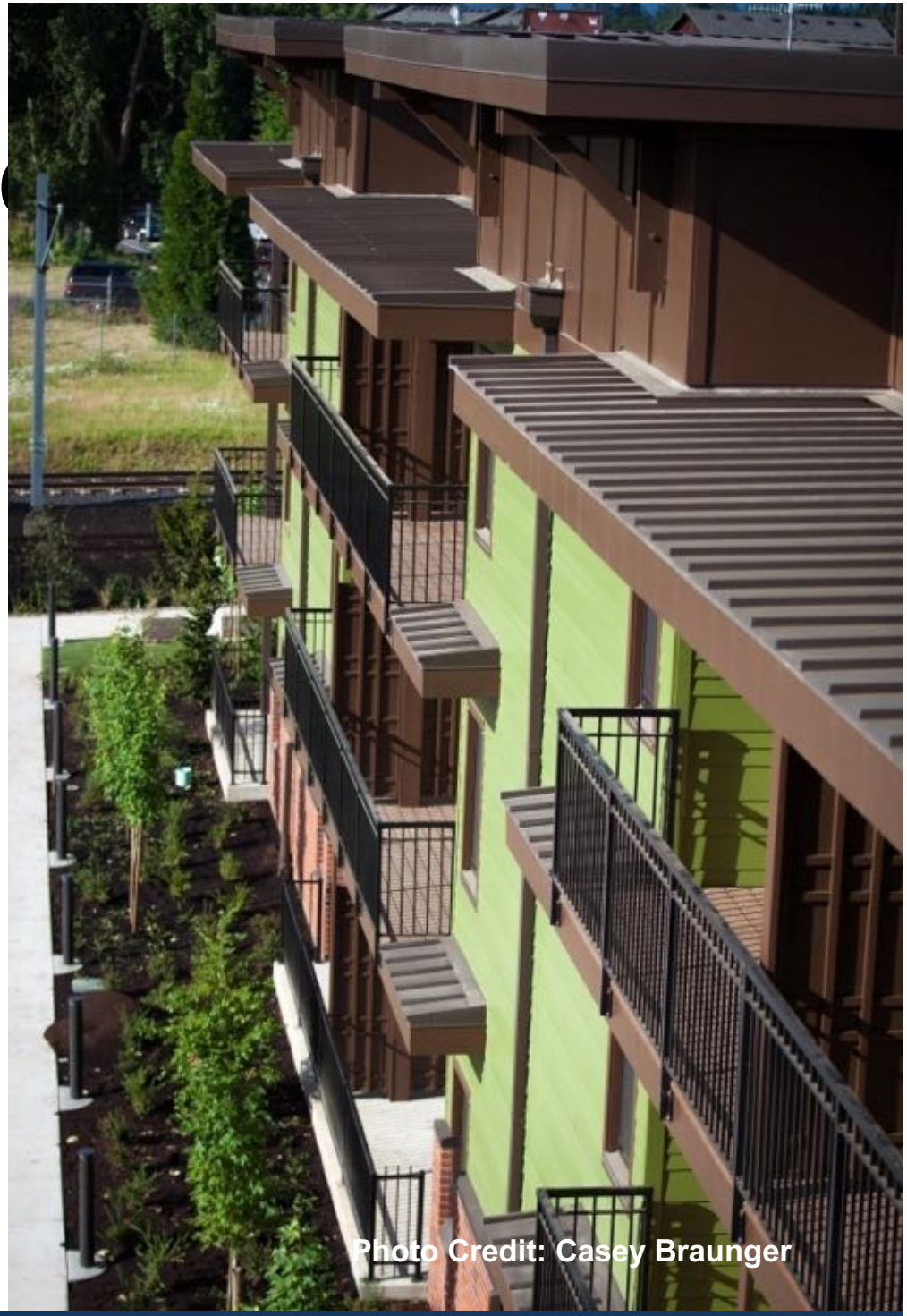

Photo Credit: Casey Braunger

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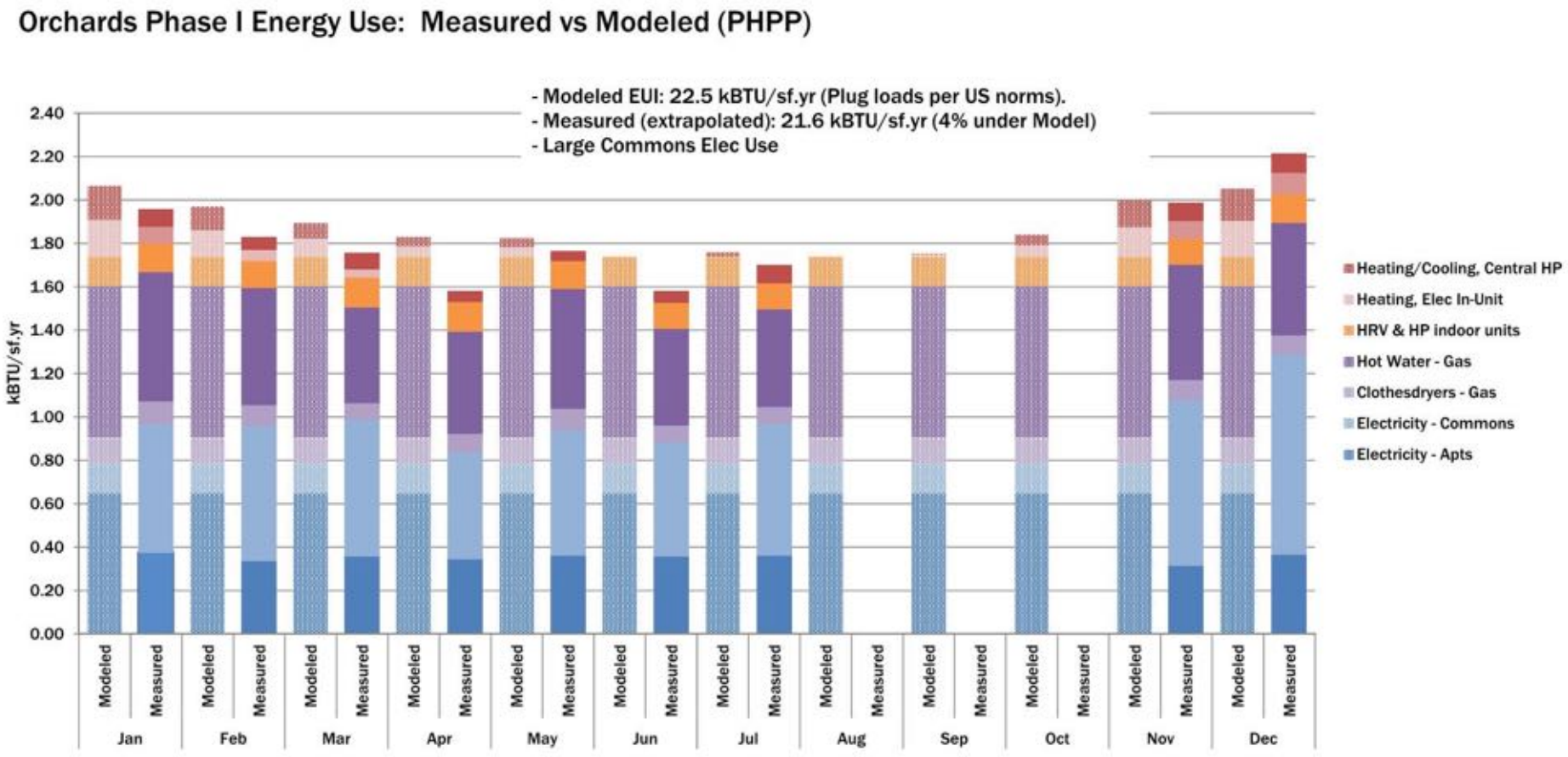
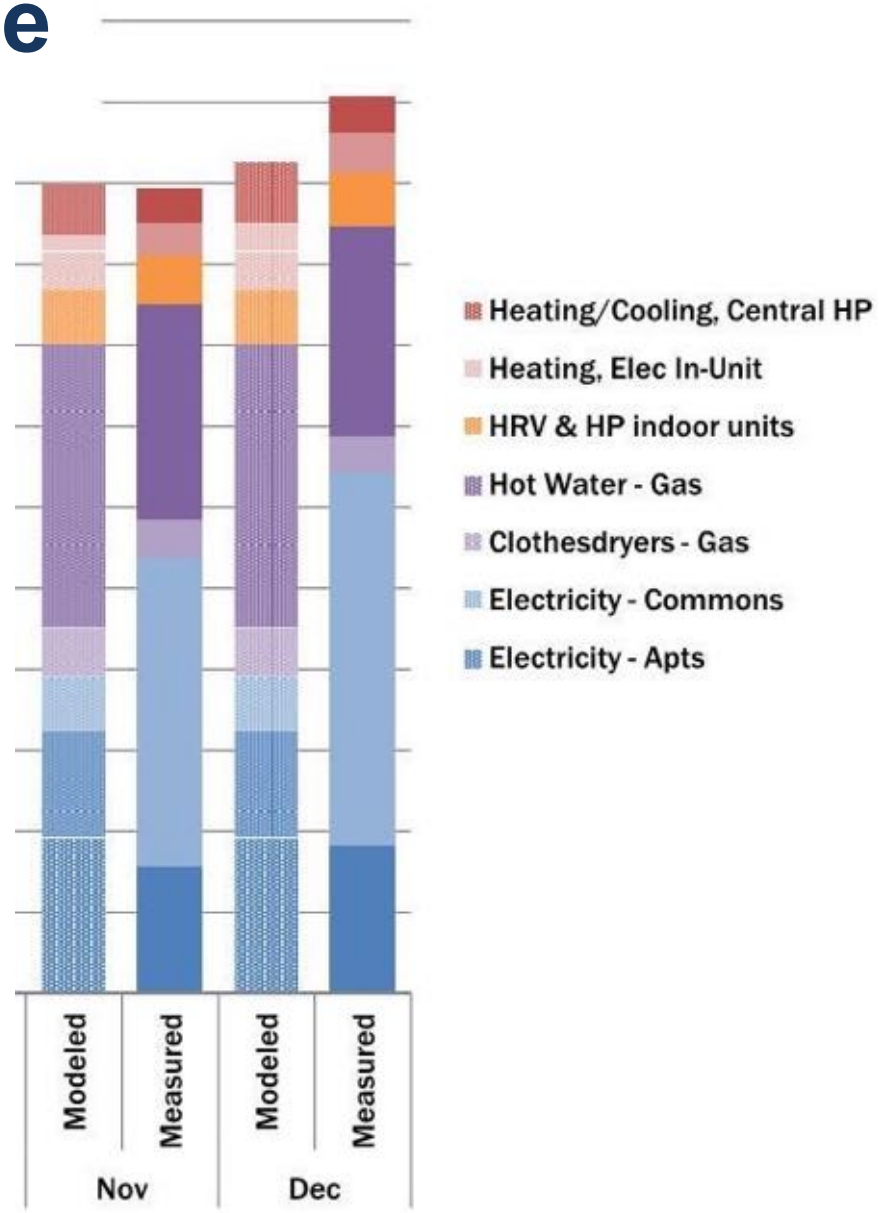
Measured Performance



Graph courtesy of REACH Community Development / Housing Development Center

Measured Performance

- Apartments energy use lower than modeled
- Common area electricity use much higher than modeled
  - Causes have been investigated
  - Fan at 3rd floor storage room that should be on timer is running continuously
  - Elevator usage higher than anticipated
  - Thermostats at freeze protection heaters in stairwells had been set at 70 degrees, have now been set to 45 degrees
  - DAS system added late during construction was not in original model (increasing site EUI slightly: approx. 0.2 kBTU/sf/yr)



Cost Premium & Financing

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**

Analysis courtesy of
Housing Development Center

Would We Do It Again?

Orchards at Orenco Phase II

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Innovation Towards Replication

- Best Overall Project and Best Affordable Project, 2015, PHIUS
- Sustainable Project of the Year, 2015, Portland Business Journal
- Golden Hammer Award for Best Project, 2015, Oregon Opportunity Network
- Energy Efficiency Project of the Year & People's Choice Award, 2016, Daily Journal of Commerce
- Best Green Project, 2016, Affordable Housing Finance Magazine's Reader's Choice Award
- Featured in Dwell, Portland Monthly, Politico, Alaska Airlines' in-flight magazine, and local newspapers

Orchards Phase I vs. Phase II

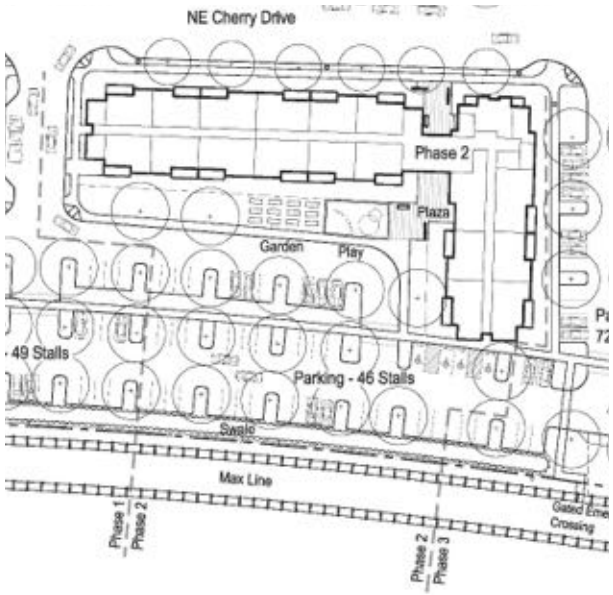
Phase I
(PHIUS+ Certified)

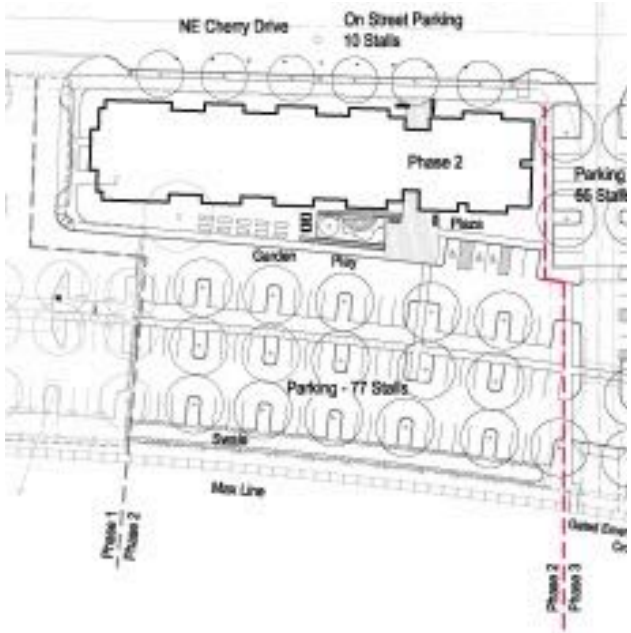
- Innovate to meet REACH strategic goal of building Passive House
- REACH brought significant private investment for this innovation

Phase II
(Passive House Inspired)

- Reduce costs to meet OHCS cost containment limits
- Additional private resources not available
- Take lessons learned & best practices from Phase I

Design Response to Cost Containment



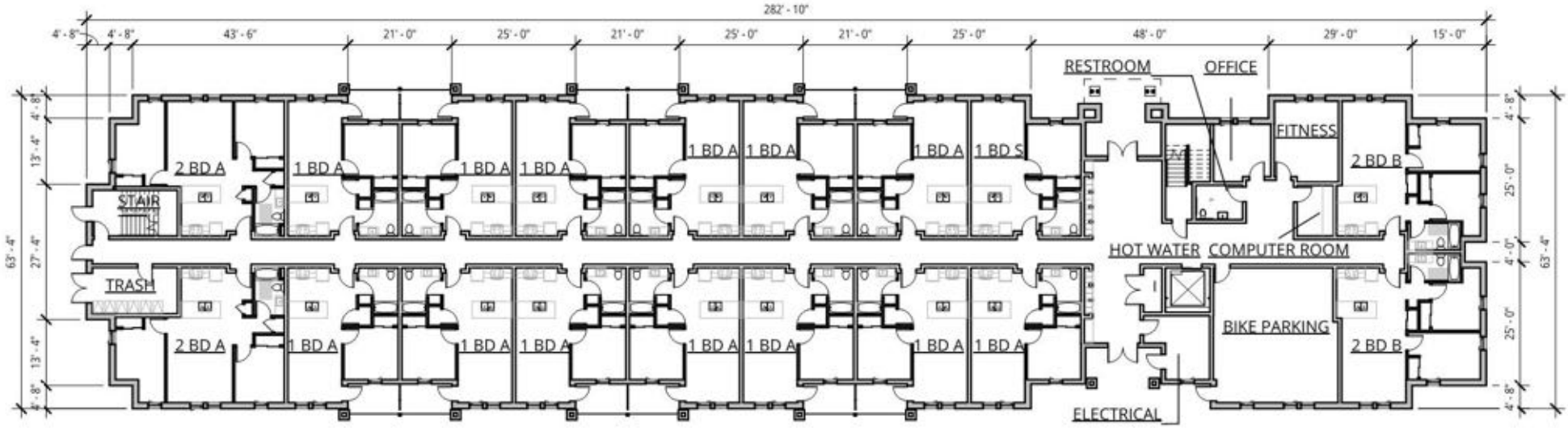


Phase II (original design)

- L-shaped building with 46 parking stalls
- 57 units in 57,750 SF
- Shallow units to increase daylight
- Community room, office

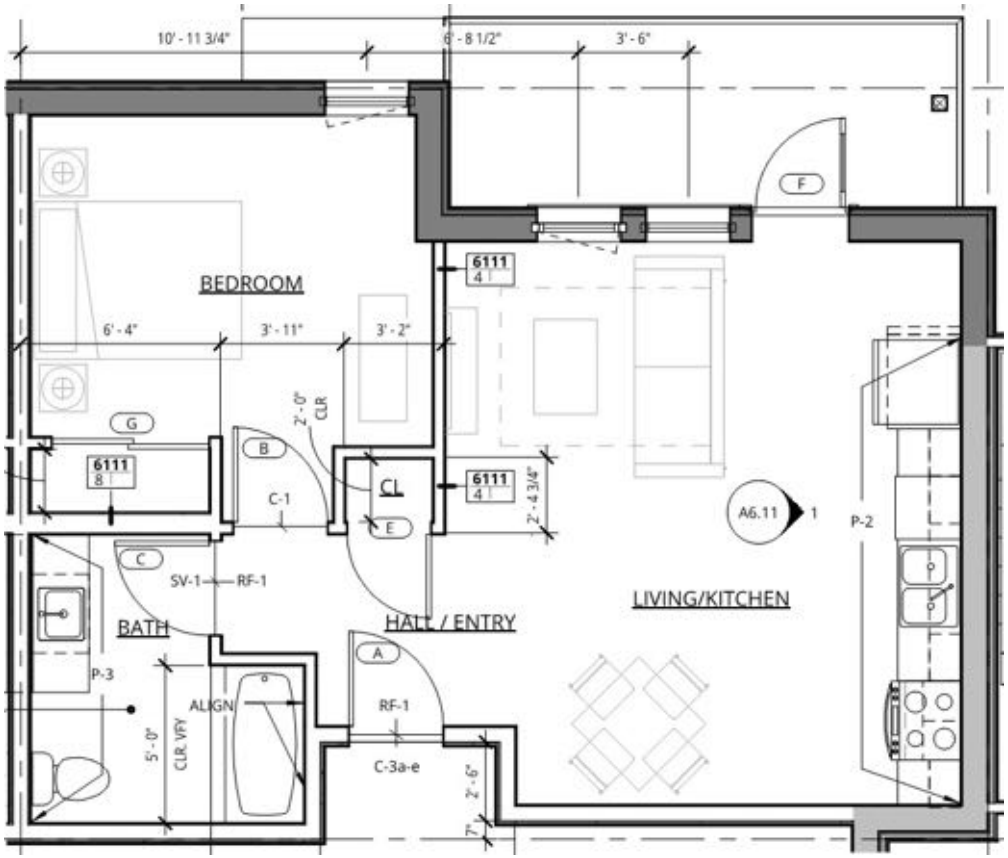
Phase II (after design revisions)

- Bar building with 77 parking stalls
- 58 units in 49,900 SF
- Deeper, narrower units
- Reduced number of balconies
- Reduced amenity space



First Floor Plan

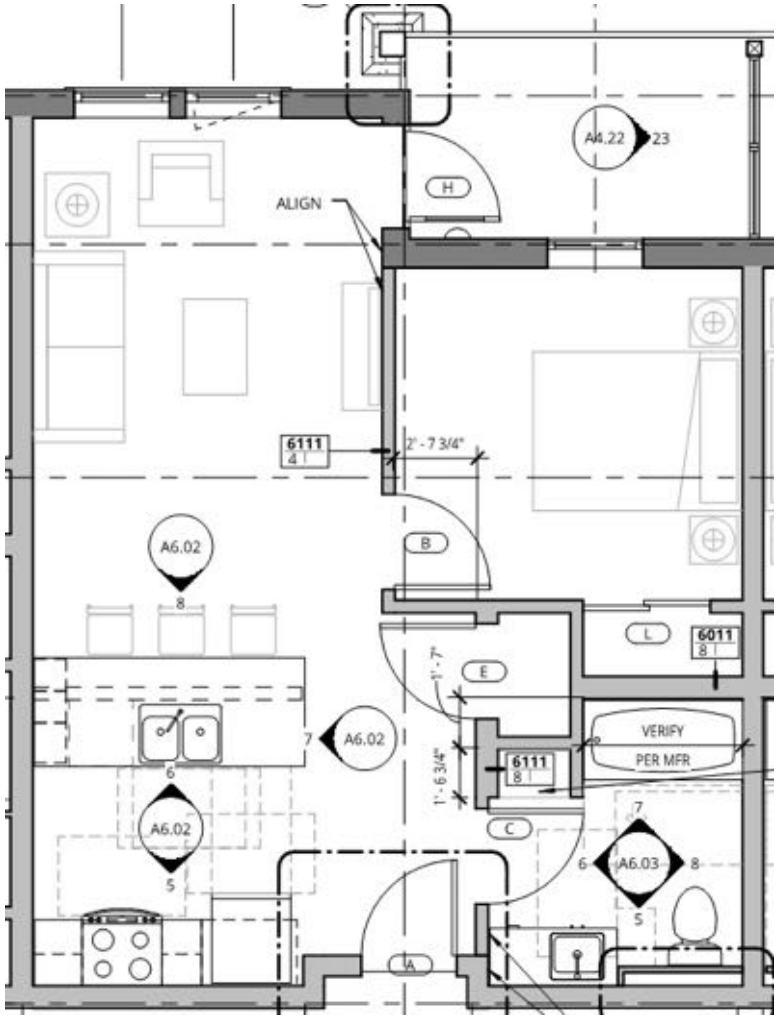
Wide and Shallow…



CORRIDOR

Phase I Typ. 1 BR

Narrow and Deep…



CORRIDOR

Phase II Typ. 1 BR

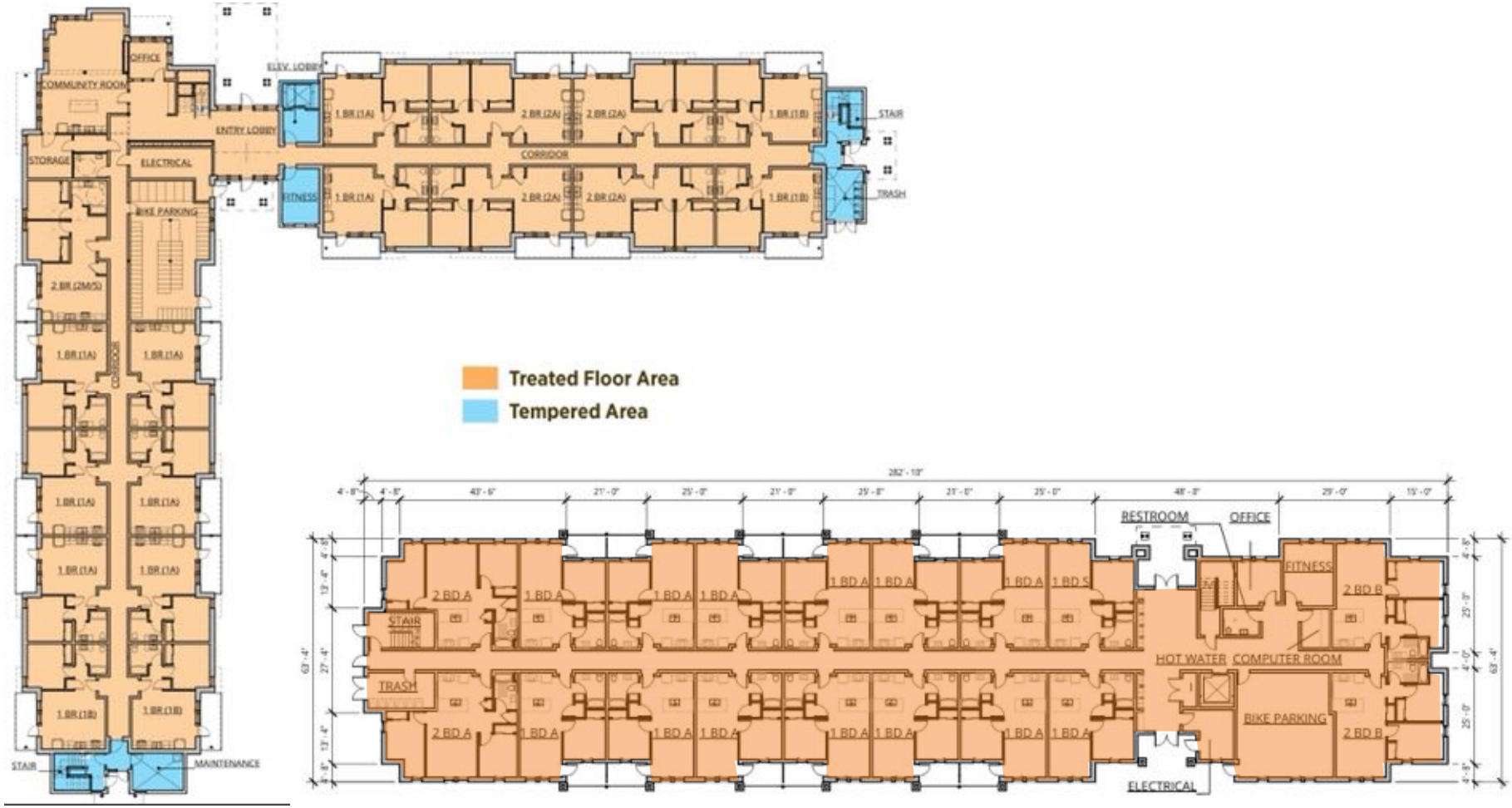
Orchards Phase I & II

Phase I
(PHIUS+ Certified)

- Envelope
  - Fully insulated slab & footings
  - 2x10 walls with 1 ½” exterior insulation
  - Triple-glazed windows
  - Low-slope roof with R-81 insulation
- Whole building ERV with heat pump
- Spaces outside conditioned envelope = very expensive doors & detailing
- Ultra airtight: 0.13 ACH50
- Extended sequencing / duration

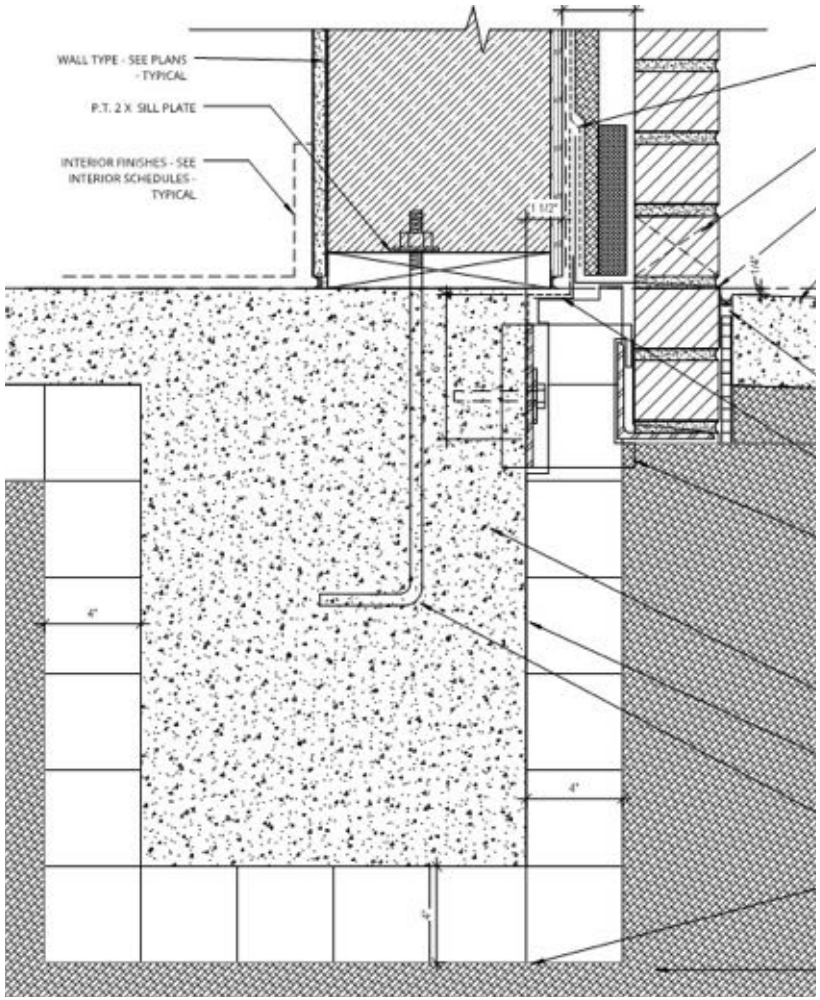
Phase II
(pursuing PHIUS+ Certification)

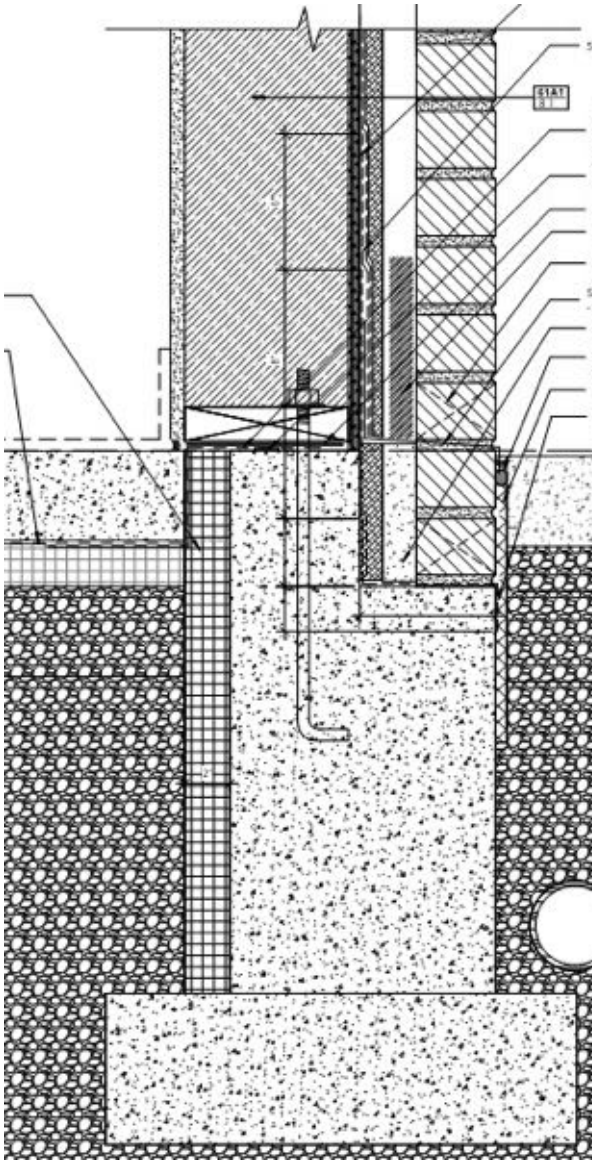
- Envelope
  - Insulated slab. No insulation under footings
  - 2x8 walls with 1” exterior insulation
  - Triple-glazed windows
  - Steep-slope roof with R-60 insulation
  - Vented attic
- Reduced vertical envelope area
  - 35,000 SF → 27,700 SF
- Same HVAC as Phase I, but with better zoning due to orientation of building
- All spaces inside conditioned envelope



Phase I – Areas Outside PH Envelope

Phase II – All Areas Inside PH Envelope

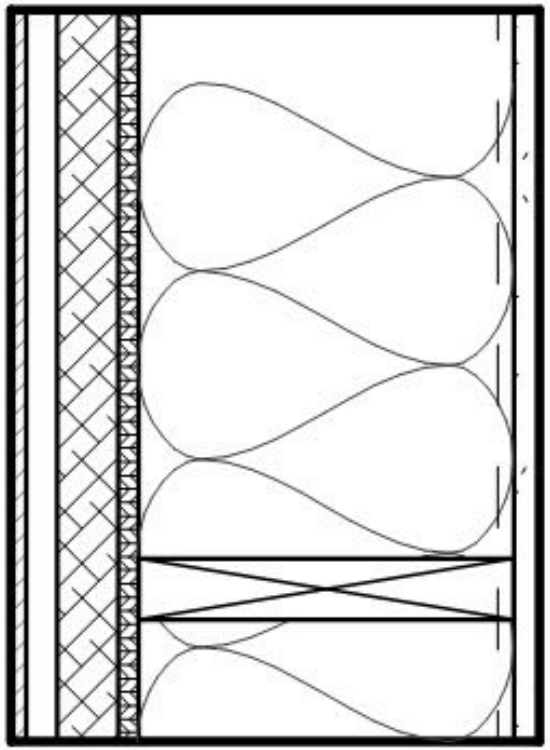




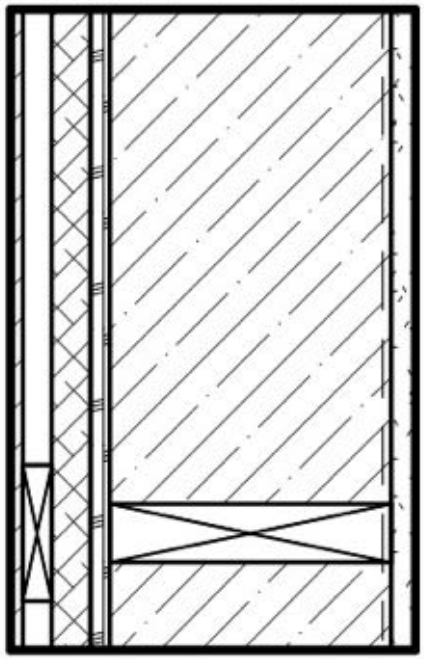
Phase I Foundation

Phase II Foundation

1 ½” Exterior Insulation
2 x 10 Wall Framing

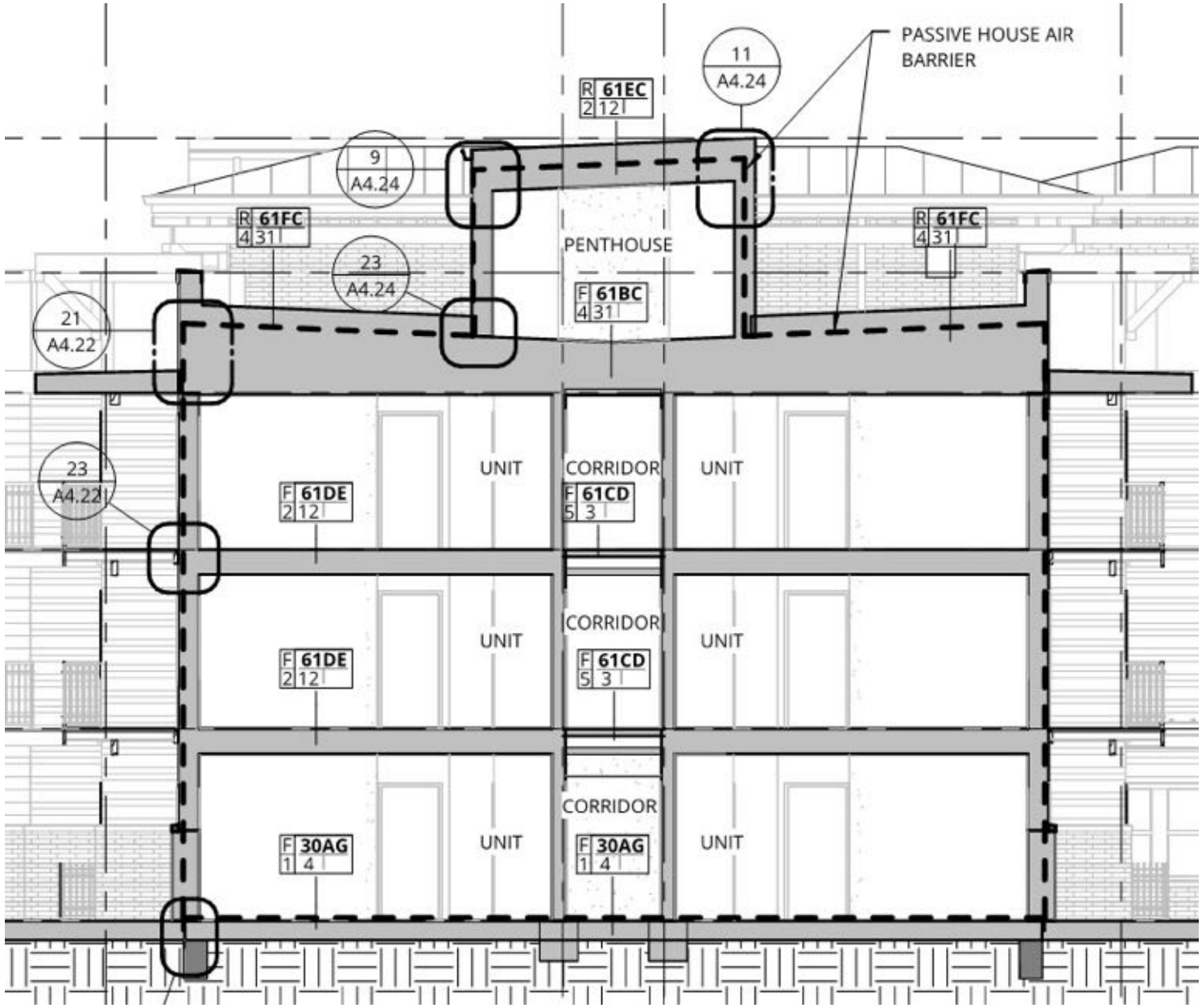


1” Exterior Insulation
2 x 8 Wall Framing

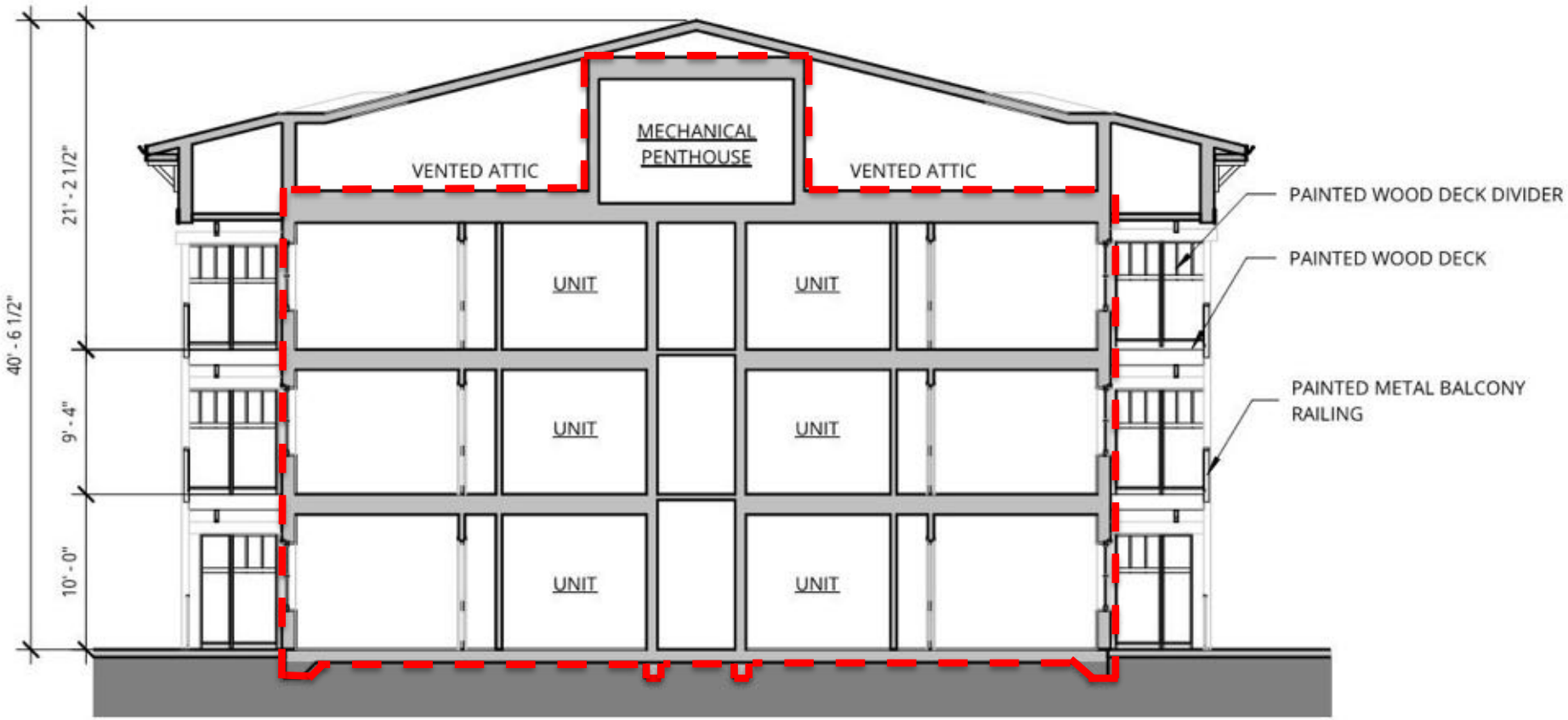


Phase I Ext. Wall

Phase II Ext. Wall



Phase I Building Section



Phase II Building Section

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GP
GP
Sheathing

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Phase II - Performance

- Modeled Performance: EUI = 22.2

Phase II - Lessons Learned

- Airtightness
  - A major challenge at steep slope roof with vented attic…
- Cost premium to achieve Passive House certification can be effectively reduced through more inherently efficient design
- Construction cost: $173/SF, $147k/unit)
  - 8% cost/unit reduction from Phase I
  - 15%+ cost reduction if factoring in market escalation…

Passive Measures - Incremental Costs

- Foundation insulation
- Wall framing
- Exterior insulation at cladding
- Triple-glazed windows (if required)
- Heat recovery at ventilation system
- Materials and labor to achieve airtightness
- Traction elevator
- Certification
- Quality assurance / verification

Orchards Phase I & II - Costs

Phase I
(PHIUS+ Certified)

- TDC of $14.5M
- $255K/unit
- Construction cost: $9,093,040
- $158/SF
- $159,527/unit
- Energy performance:
  - 5 energy models
  - 31-71% better than code

Phase II
(PHIUS+ Certified)

- TDC of $13.6M
- $234K/unit
- Construction cost: $8,531,624
- $173/SF
- $147,097/unit
- Energy performance:
  - 3 energy models
  - 29-67% better than code

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  - Actual data available in 2017

Orchards at Orenco - Proof of Concept

- When implemented with knowledge and skill, passive building measures are cost effective AND provide substantial benefits:
  - Enhanced comfort, health and durability
  - Energy use reduction, leading to operational cost savings
- Orchards at Orenco demonstrates that passive building measures can be implemented at multifamily housing for little additional first cost
- **Life cycle cost & quality benefits likely to far exceed the additional investment at project inception**

ORCHARDS AT ORENCO, PHASE I

ORCHARDS AT ORENCO, PHASE II

More Information & Insights

- REACH Community Development:
  - http://reachcdc.org/main/docs/housing_development/Orchards_PH_Case_Study.pdf
  - http://reachcdc.org/main/docs/housing_development/Orchards_at_Orenco_I_Development_Profile_update_Aug_2015.pdf
- Housing Development Center:
  - http://www.housingdevelopmentcenter.org/our-work/buildings/orchards-at-orenco/
- Ankrom Moisan Architects:
  - https://www.youtube.com/watch?v=ewJUCWI6dqM
- PHIUS Case Study:
  - http://www.phius.org/phius-certification-for-buildings-and-products/case-studies/orchards-at-orenco-phase-i
- BEST 4 Conference Paper:
  - http://walshconstructionco.com/2015/04/walsh-presents-at-best-4-building-enclosure-science-and-technology-conference/
- Guest Blog on Green Building Advisor:
  - http://www.greenbuildingadvisor.com/blogs/dept/guest-blogs/largest-passivhaus-building-us

Q & A

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This concludes The American Institute of Architects Continuing Education Systems Course