Orchards at Orenco & Beyond…
Finding Our Way To Higher Levels of Efficiency While Managing Costs

Mike Steffen
Walsh Construction Co.

NAPHC
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Orchards at Orenco

Photo Credit: Casey Braunger
Orchards at Orenco

• 167 unit affordable housing development in Hillsboro, Oregon (western suburb of Portland)
• Three phases
• 2012: design commenced
• 2018: construction will be complete
• Developer/Owner:
  – REACH Community Development
Orchards at Orenco  Hillsboro, Oregon

Image courtesy of Ankrom Moisan Architects
Orchards at Orenco Ph. I

- 57 units of affordable workforce housing
- 57,750 SF building
- Completed June 2015
- PHIUS+ certification
  - Based on PHI Passivhaus Standard
Orchards at Orenco - Team

Owner/Developer: REACH Community Development

Owner’s Representative: Housing Development Center

Architect of Record: Ankrom Moisan

General Contractor: WALSH Construction Co.

Passive House Consultant: green hammer

Design Architect: William Wilson Architects

Mechanical Engineer: PAE

Structural Engineer: Stonewood Design

Civil Engineer: Humber Design Group, Inc.

Landscape Architect: Walker Macy

PHIUS+ Rater: earth advantage
Orchards Ph. I - Results

- Airtightness: 0.13 ACH @ 50Pa (measured)
Orchards Ph. I - Results

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- Modeled performance: EUI = 22.5
Orchards Phase I Energy Use 2016: Measured vs Modeled (PHPP)

- Modeled EUI: 22.5 kBTU/sf.yr (Plug loads per US norms).
- Measured 2016: 20.9 kBTU/sf.yr (7% under PHPP Model)
- Large Commons Elec Use
Orchards I: Site EUI
Measured vs 2010 Oregon code

Site EUI (kBtu/sf.yr)

Oregon Code 2010
Orchards Measured 2016

52

60% Savings

20.9

- Heating/ Cooling
- Ventilation
- DHW
- Units/Common
Orchards Ph. I - Results

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• Measured performance: EUI = 20.9
Orchards Ph. I - Results

- Airtightness: 0.13 ACH @ 50Pa (measured)
- Modeled performance: EUI = 22.5
- Measured performance: EUI = 20.9
- Construction cost: $159,000/unit ($158/sf)
  - 11% cost premium over typical Orenco project by REACH
Orchards at Orenco Ph. II

Photo Credit: Sally Painter
Orchards at Orenco Ph. II

- 58 units of affordable workforce housing in Hillsboro, Oregon
- 49,900 SF building
- Completed July 2016
- PHIUS+ certification
  - Based on PHIUS+ 2015 Passive Building Standard (North America)
Orchards at Orenco

- PHASE I - 2015
- PHASE II - 2016

Image courtesy of Ankrom Moisan Architects
Orchards Phase I → Orchards Phase II

**Phase I**
(PHIUS+ Certified)

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

**Phase II**
(Passive House “Informed”)

- Goal: Reduce costs to meet OHCS cost containment limits
- Additional private resources not available
- Take lessons learned & best practices from Phase I
Orchards Ph. II - Key Measures

- **Highly** compact form
- **Optimized orientation** (east-west)
- Well-managed window to wall ratio
- Solar shading
Design Response to Cost Containment

Phase II (original design)
- L-shaped building
- Shallow units to optimize for daylight
- 57 units in 57,750 SF
- Community room, office

Phase II (after design revisions)
- Bar building, with E-W orientation
- Deeper, narrower units to optimize for compactness ("form factor")
- 58 units in 49,900 SF
- Reduced number of balconies
- Reduced amenity space
- Reduced open space
Looking At Unit Plans

Orchards Ph. I: 656 square feet
30 feet wide

Orchards Ph. II: 608 square feet
23 feet wide
Looking At Unit Plans

Vertical Enclosure Area = 340 SF

Common Area (Corridor) = 108 SF

Vertical Enclosure Area = 270 SF
(20% reduction)

Common Area (Corridor) = 74 SF
(32% reduction)
Efficient planning result:

58 units in 49,900 SF (vs. 57 units in 57,750 SF)

First Floor Plan
Orchards Phase I & II

**Phase I**
(Passive House 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**
(Passive House “Informed”)

- 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
- Airtight??????
- Typical sequencing / duration
Orchards Ph. II - Key Measures

- **Highly** compact form
- **Optimized orientation** (east-west)
- Well-managed window to wall ratio
- Solar shading

- Thermally isolated foundation (2” EPS foam)
- “High R” walls (R-31)
  - 2x8 w/ blown fiberglass, 1” mineral wool (exterior)
- “High R” windows (R-6)
- Air barrier system (with **vented attic** --- TOUGH!)
Orchards Ph. II - Key Measures

• Balanced ventilation system with heat recovery
  – Direct ducted fresh air to apartments
• Electric resistance heating at apartments (no cooling)
• Efficient lighting
  – Pin-based CFL in apts., LED w/ controls in common areas
• Efficient appliances
  – Energy Star upper tier
• Traction elevator
• Centralized DHW system with high-efficiency boilers

• Solar thermal preheat on DHW
Building Section

Image courtesy of Ankrom Moisan Architects
PHIUS+ Certification

• As design began, REACH called for Phase II to use lessons learned and best practices from Phase I while reducing costs to keep within cost containment limits set by state’s housing agency

• As construction began, the building design was modeled in both PHPP and WUFI Passive

• Determined that design complied with requirements of the PHIUS+ 2015 Passive Building Standard

• REACH decided to pursue certification for Phase II
Orchards Ph. II - Results

- Airtightness: 0.59 ACH @ 50Pa (measured)
Orchards Ph. II - Results

- Airtightness: 0.59 ACH @ 50Pa (measured)
- Modeled performance: EUI = 22.2
Orchards Ph. II - Results

- Airtightness: 0.59 ACH @ 50Pa (measured)
- Modeled performance: EUI = 22.2
- Measured performance: TBD
Orchards Ph. II - Results

- Airtightness: 0.59 ACH @ 50Pa (measured)
- Modeled performance: EUI = 22.2
- Measured performance: TBD
- Construction cost: $147k/unit ($173/sf)
  - 8% cost/unit reduction from Phase I
    (15%+ cost reduction if factoring in market escalation...)
  - 5% cost premium to achieve Passive House
Orchards at Orenco - Lessons Learned

• Owner vision - and commitment - is pivotal
Orchards at Orenco - Lessons Learned

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• It takes a team...working collaboratively, with everyone pulling in the same direction
Phase I - Lessons Learned

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• Early team integration pays off
Phase I - Lessons Learned

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- Proactive coordination and QC is essential
Phase I - Lessons Learned

- 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
Key Passive Measures That Add Cost

- Foundation insulation $-$
- Wall framing $
- Exterior insulation $$-$$$$
- Triple-glazed windows (if required) $$$
- Heat recovery at ventilation system $$
- Materials and labor to achieve airtightness $-$$$$
- Traction elevator $$

- Certification $
- Quality assurance / verification $
Orchards at Orenco - Proof of Concept

• When implemented with knowledge and skill by a diligent & integrated team, passive building measures are cost effective AND provide substantial benefits:
  – Enhanced comfort, health and durability
  – Energy use reduction, leading to operational cost savings, and reduced environmental impact

• 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 time of construction
WHY?

- WHY are we not doing this on ALL affordable housing moving forward?

- WHY are we not doing this on ALL multifamily housing moving forward?

- “Split incentive” is potential issue for market-rate housing...shouldn’t be for affordable housing

- Cost???
Orchards at Orenco Ph. III
Orchards at Orenco Ph. III

- 52 units of affordable workforce housing
- 62,750 SF building
- To be completed September 2018
- Not pursuing Passive House certification

- Construction cost: $187k/unit ($155/sf)
  - Two years of high cost escalation in Portland market
Managing Costs to Achieve Passive House
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HOW?

• Cost Efficient Design and Construction (CEDC)
  – Optimized unit plans as basic building blocks for ultra-efficient building layouts
  – Scale
  – Standardization

• Lean Methods
  – Integration / Collaboration (incl. subs)
  – Target Value Design (TVD)
  – Pull Planning
  – Eliminating waste...
Q & A