DESIGN STUDIO

Trials and Tribulations of Energy Efficient Residential Construction

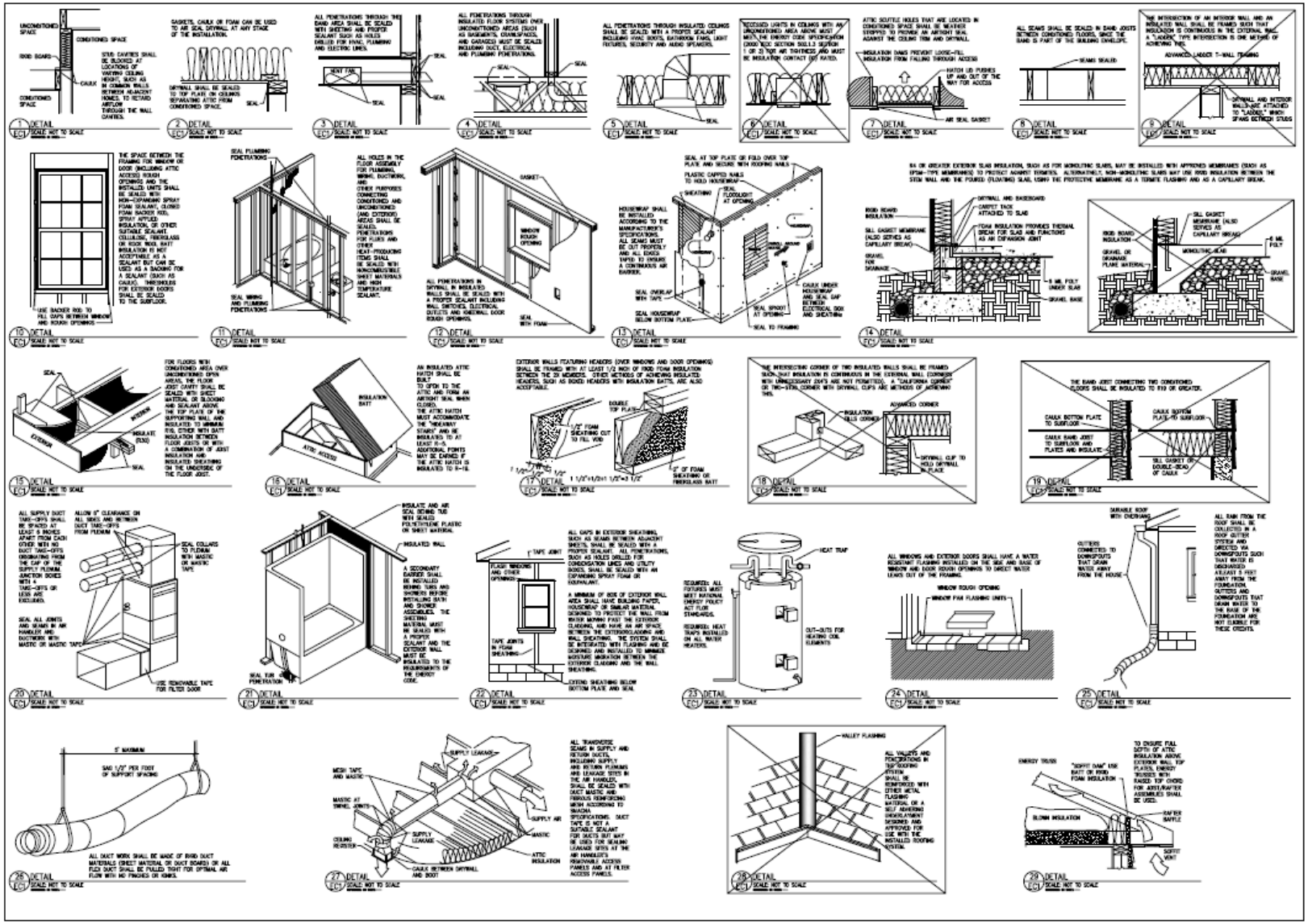
January 14, 2015




Average HERS 73

Average HERS 65

Energy Efficient Details



DESIGN STUDIO

Grissom Lane Case Study

January 14, 2014 – Colin Arnold and Benjamin Knopp

Design

Summary

- Layout: 4 Duplexes, 8 Units
- Square Footage: 950ft^2 each, 7,600ft^2
- 2 Bedrooms and 1 Bathroom

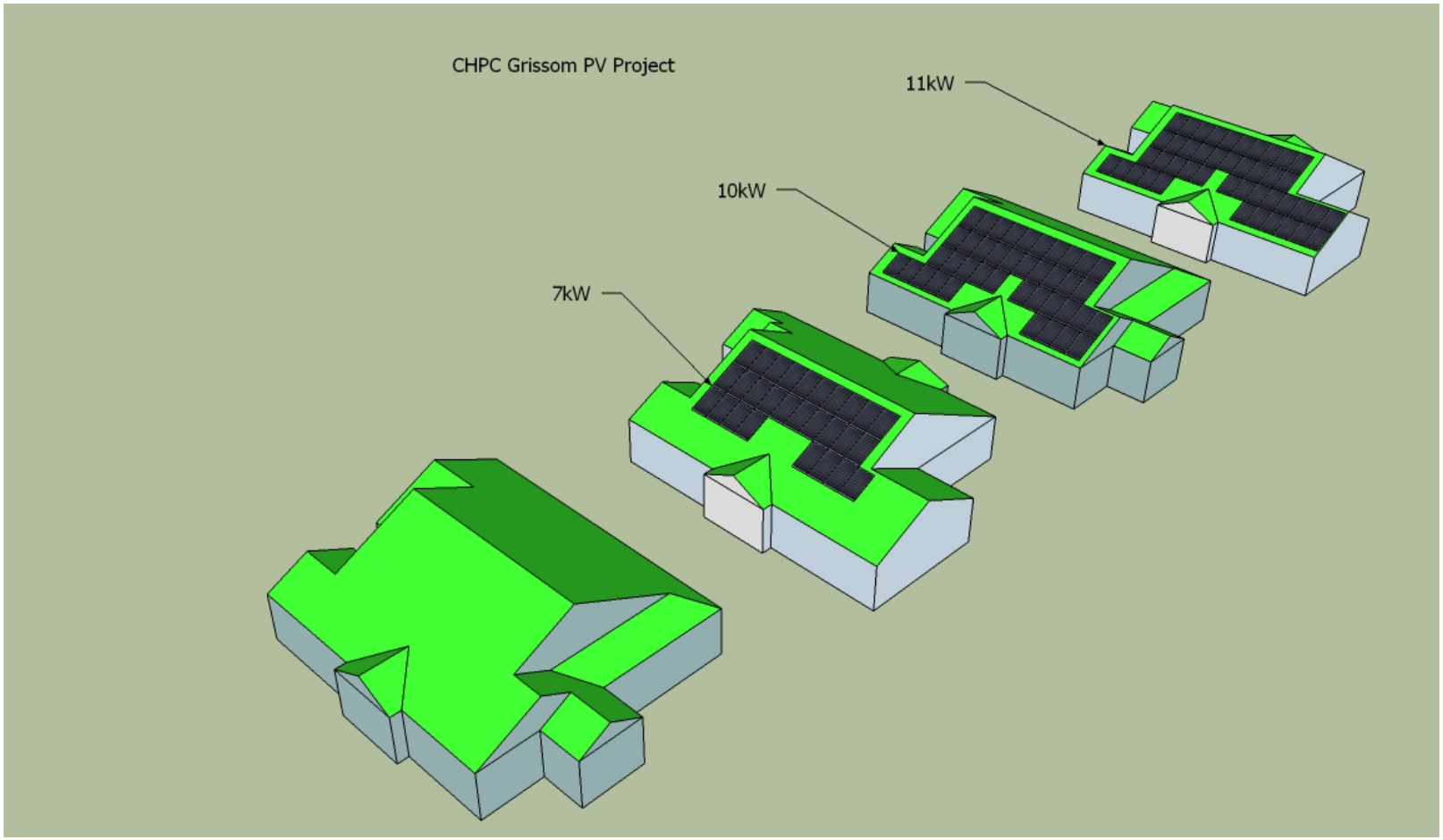
Design

Summary

- Floor Plan

Design

Summary: Solar Layout



Design

Summary

- Elevation

Design

Summary: Special Features

- Accessibility: fully accessible with UD
- Storage: Closets

Design

Summary: Special Features

- Aesthetics: FCB siding, front/rear porches, wood flooring, 9ft ceilings, gazebo, walking loop, raised plant beds

Design

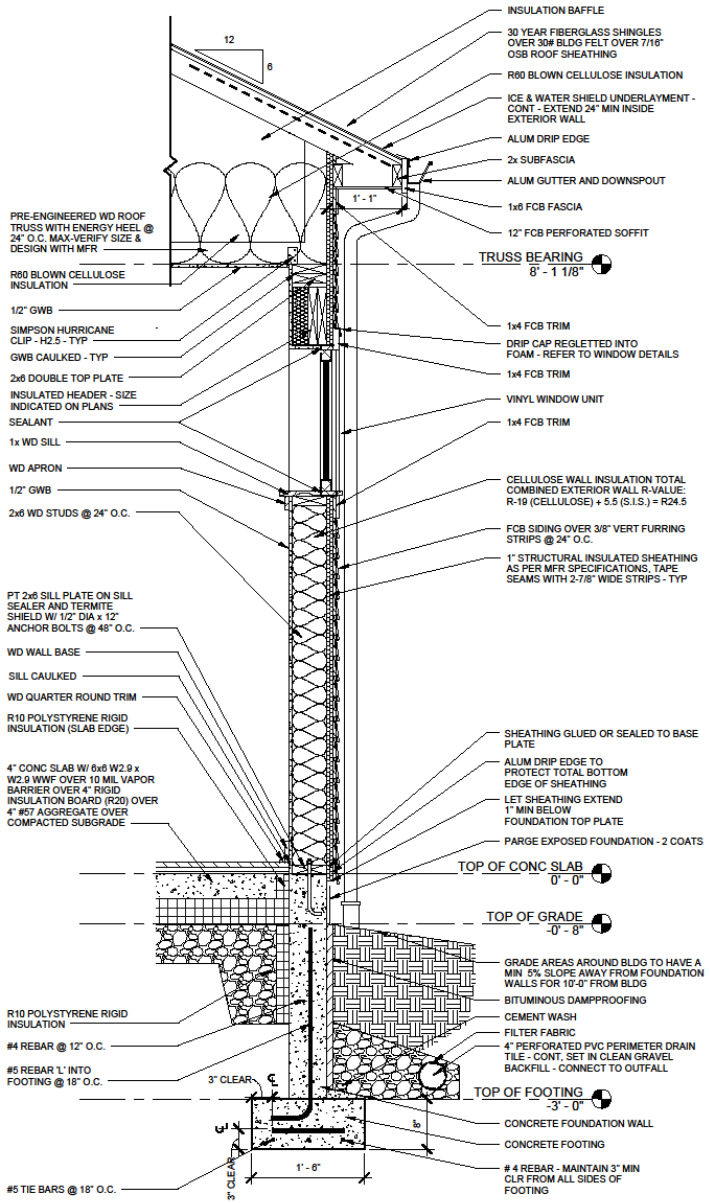
Summary: Special Features

- Etc.: Pedestrian connectivity, bus stop

Design

Building Envelope

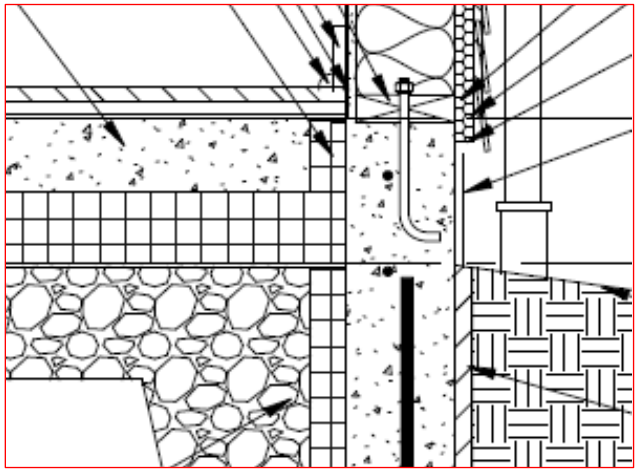
- Section Details

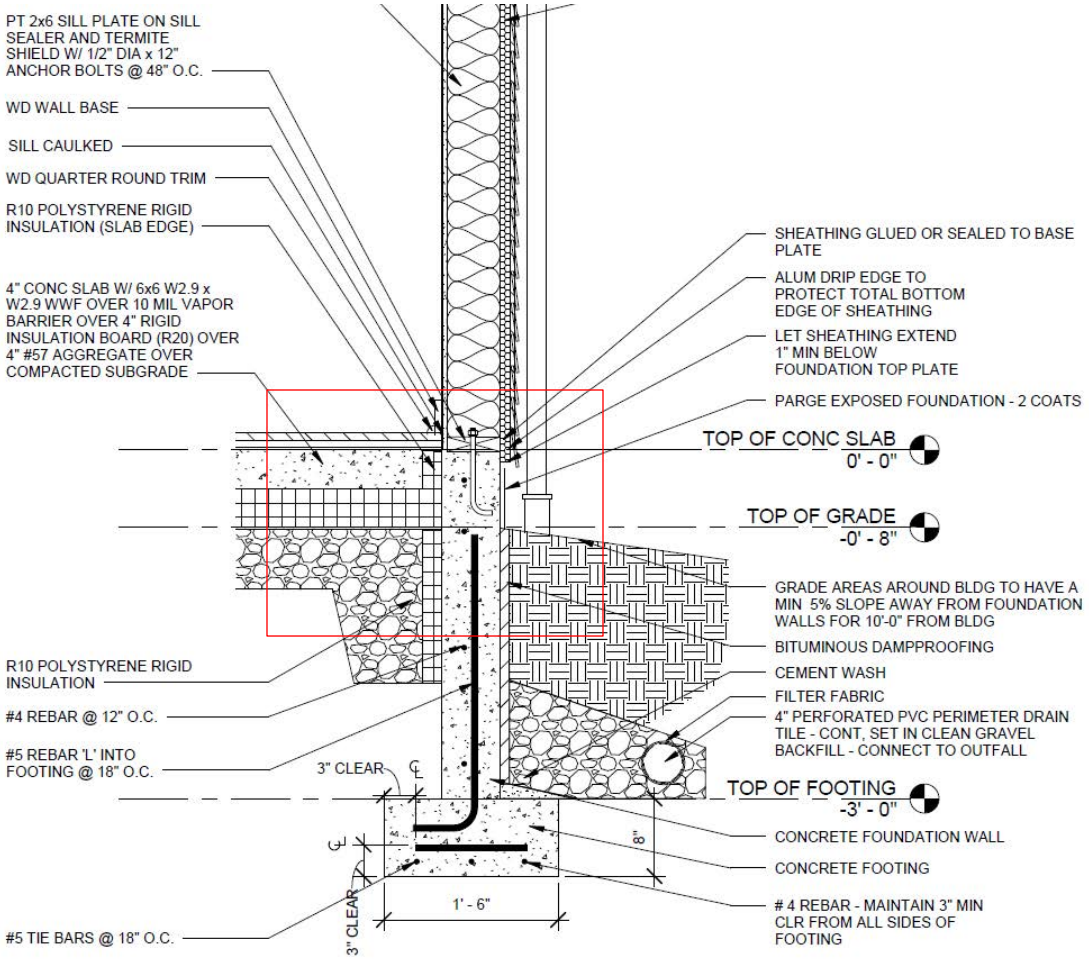


Design

Building Envelope: Foundation

- Foundation Details





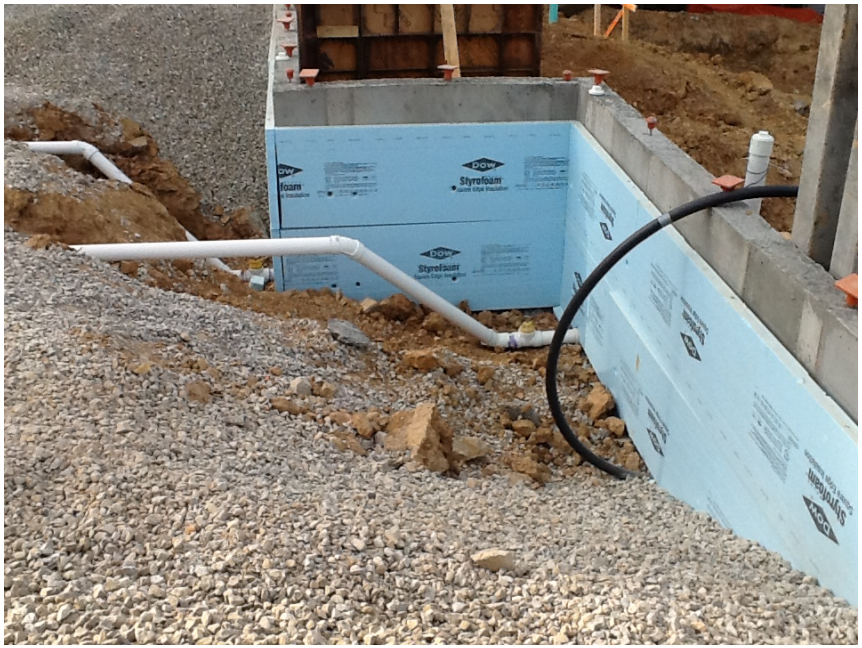
Design

Building Envelope: Foundation

- Air Sealing: Caulked sill
- Insulation: 4" EPS under slab, 2" EPS inside perimeter of foundation wall
- Moisture Control: 10 mil vapor barrier

Design

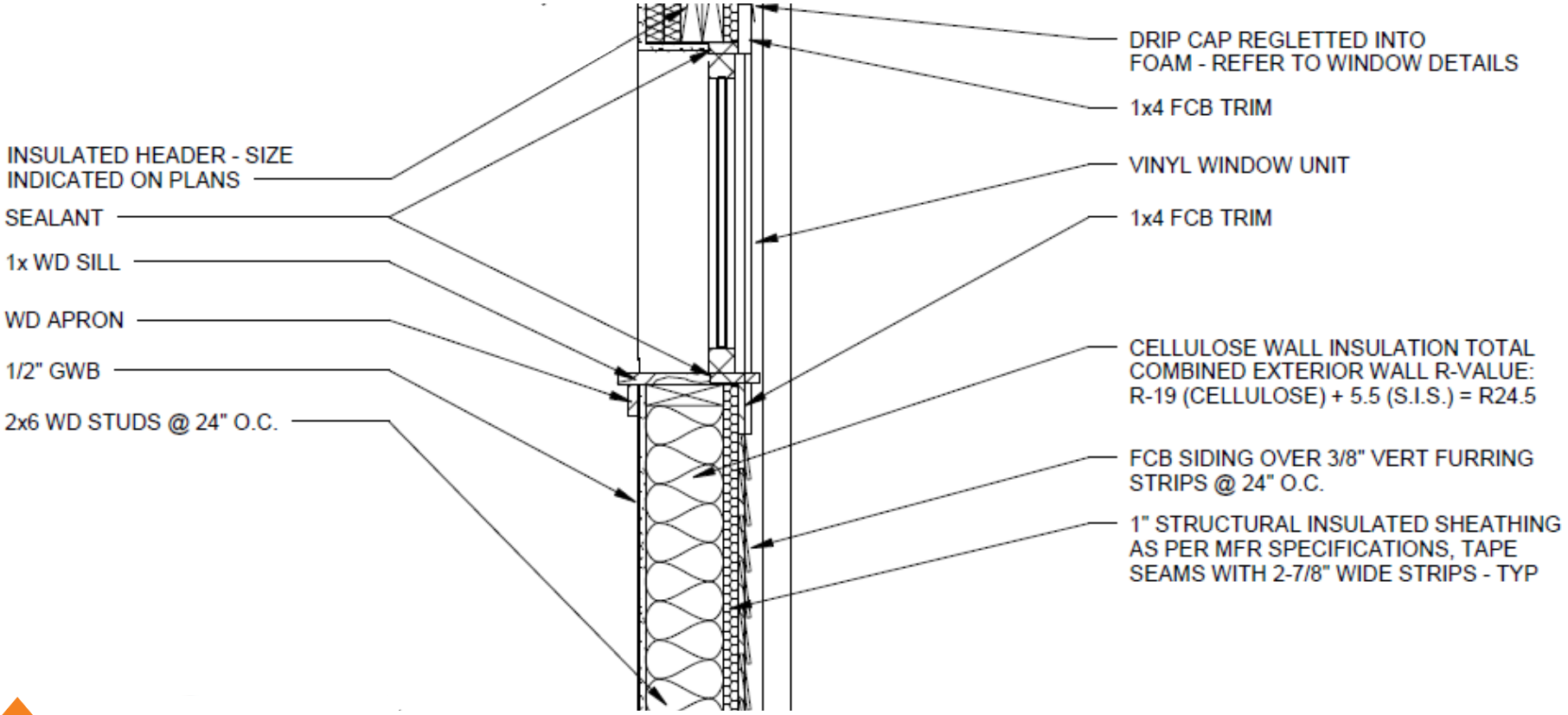
Building Envelope: Foundation



Design

Building Envelope: Walls

- Wall Details



Design

Building Envelope: Walls

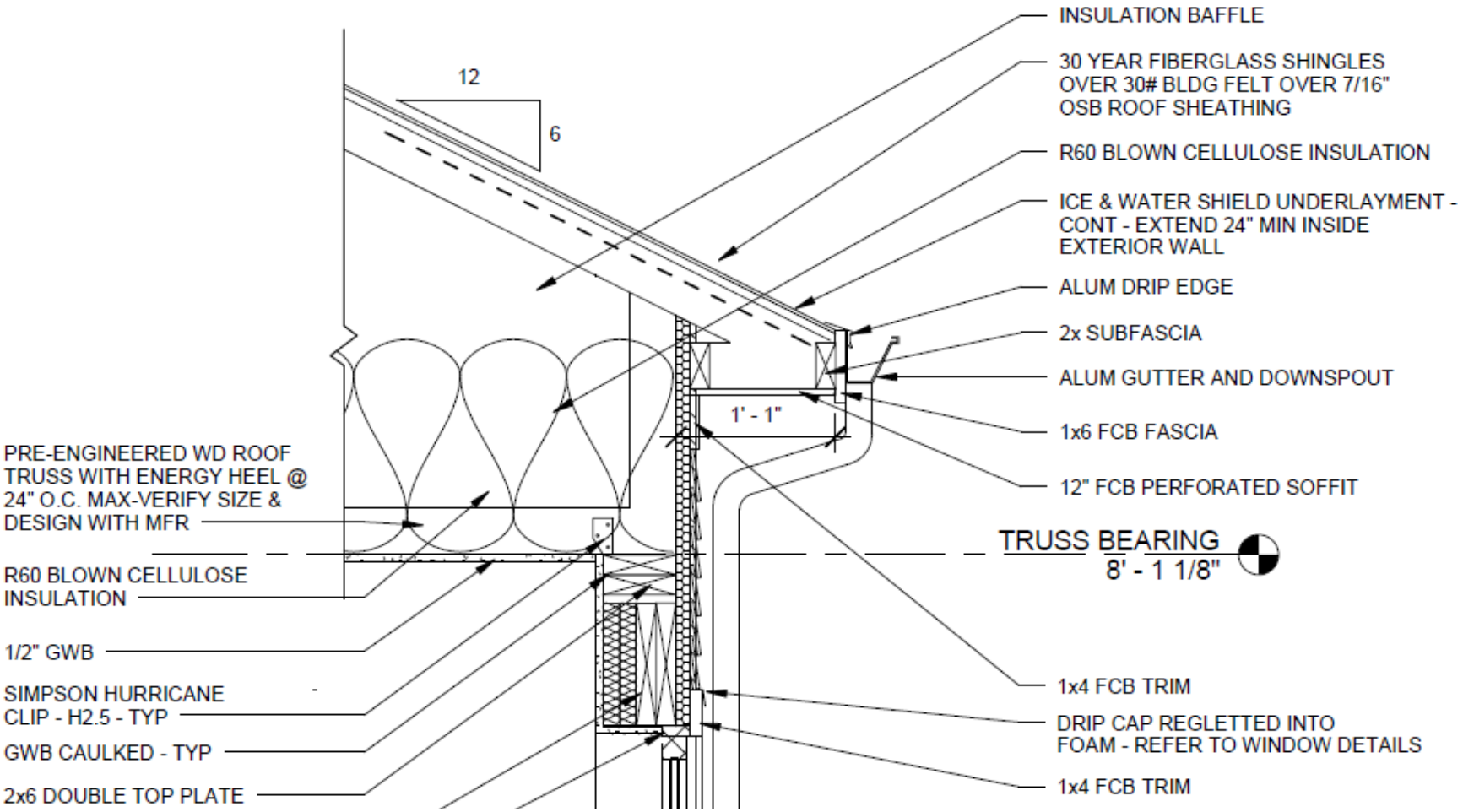
- Air Sealing: Continuous SIS taped at seams, drywall caulked and foamed
- Insulation: R-19 blown cellulose + R-5.5 SIS, insulated headers, open corners
- Moisture Control: SIS taped at seams, fiber cement board vented rainscreen, no flashing under windows

Design

Building Envelope: Walls

Design

Building Envelope: Ceiling/Roof



Design

Building Envelope: Ceiling/Roof

- Air Sealing: drywall caulked and foamed
- Insulation: R-60 blown cellulose, energy heel truss, vent chutes
- Moisture Control: 30 year shingles, ice & water shield underlayment, FCB fascia and soffit (perforated)

Design

Building Envelope: Ceiling/Roof

Design

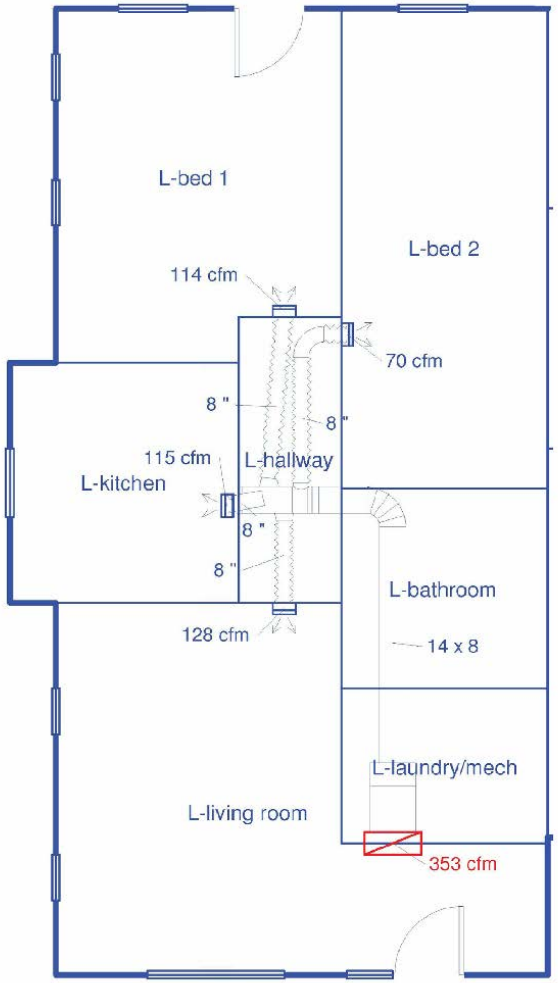
HVAC: Heating and Cooling

- Primary: Mini-split heat pump - Fujitsu ARU9RLF indoor, AOU9RLFC outdoor
- Specifications: 21.5 SEER, 12.2 HSPF
- Backup/Supplemental: none!

Design

HVAC: Air Distribution

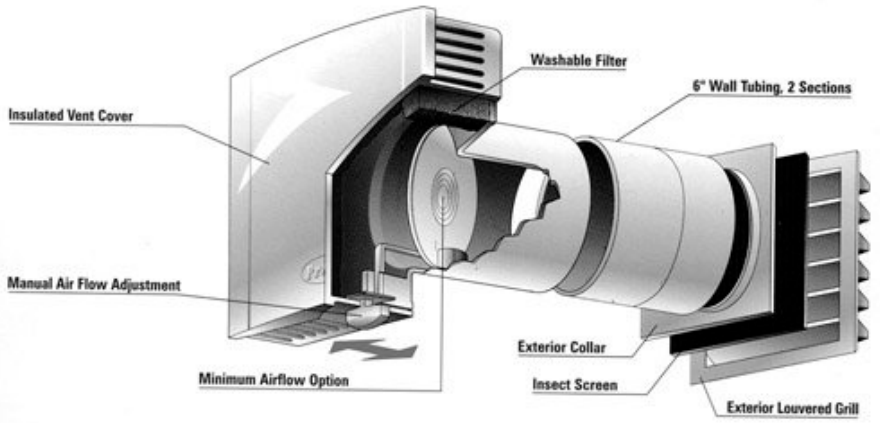
- Fan: variable speed DC
- Ducts: slim interior, low S



Design

HVAC: Ventilation

- Whole House Ventilation: exhaust-only Panasonic Whisper Green in bathroom with passive air inlets in bedrooms
- Spot Ventilation: bathroom & kitchen



Design

Water

- Water Heater: heat pump, one per building, A.O. Smith, 2.75 energy factor
- Fixtures: EPA Water Sense
- Layout: all ¾" (½" to tub)

Design

Equipment

- Washer: ENERGY STAR front loading
- Refrigerator: ENERGY STAR accessible
- Lighting: mostly LED, some CFL
- Solar: 3.78 KW per unit average
- Windows: triple-pane U-0.19, SHGC 0.22

Performance

Air Leakage

- CFM50: 308
- ACH50: 2.14 (CFM50/SFBE: 0.10)

HERS Rating

- Pre-renewables: 44
- Post-renewables: 2

Performance

Predicted Annual Energy Costs

- Heating: $88
- Cooling: $51
- Water Heating: $142
- Lights/Appliances/Other: $440
- Solar: -$688
- Total: $34

Costs

Total Construction Cost

- Sans lot and PV: $833,000, $110/sf

Construction Cost Details

- Premium Over IECC 2006:
    - Photovoltaics: $117,000
    - Rater Costs: $3,433

Lessons Learned

The Good

- Standard construction practices
- Engineered trusses with energy heel
- Standard roof sheathing, SIS on walls
- Mini-split without electric resistance
- Heat pump water heater

Lessons Learned

The Bad

- Poorly installed batt insulation
- Extensive air sealing stretched installers
- Range hood punchouts left in place
- Original 8’ ceilings too low for interior ductwork, raised to 9’ to accommodate

Lessons Learned

Cost Saving Opportunities

- Mobility/accessibility features
- Fiber cement board siding and trim
- Hardwood floors
- Photovoltaics