GREEN BUILDING & LANDSCAPING WEEK

Green Building Webinar: Lessons Learned in Passive House Design & Construction



Deborah Buelow AIA WELL AP, Cedar Architecture

Join the City of Alexandria and Cedar Architecture for a virtual Green Building Webinar. It will focus on lessons learned in the field for passive house design and construction.

OCT 29, 2026 02:00 PM

alexandriava.gov/go/8658

ECO-CITY ALEXANDRIA

CEDAR

CENTERED DESIGN ARCHITECTURE & RESEARCH









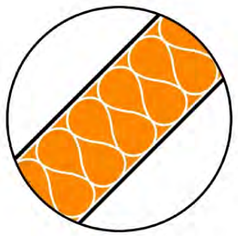


LESSON 1:

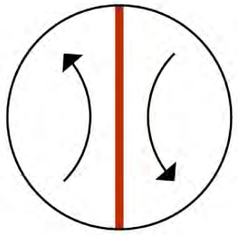
Passive House

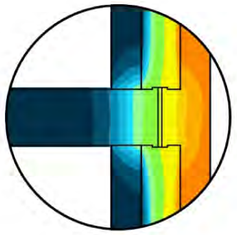
(passivhaus? passive solar? does it have to be a house?)

continuous insulation

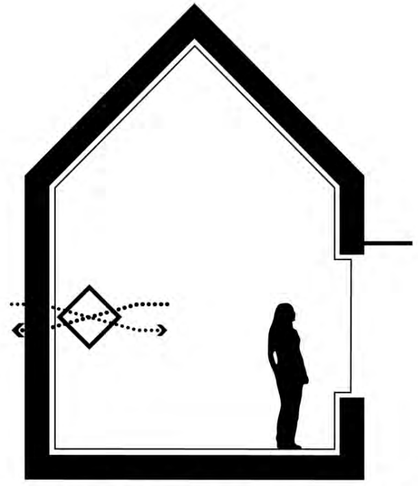


continuous air barrier

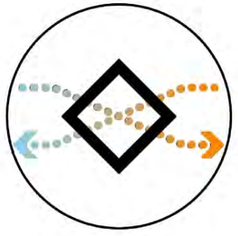


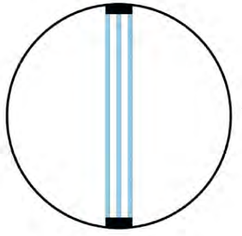


no thermal bridging



fresh air recovery



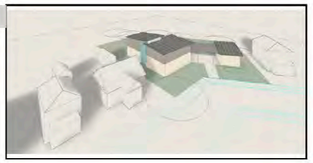


high performance
windows / doors

FIVE PASSIVE HOUSE DESIGN PRINCIPLES

Creative Commons
PassiveHouseAccelerator.com

BUILDING INFORMATION



Category:	**Residential**
Status:	**In planning**
Building type:	**New construction**
Year of construction:	**2022**
Units:	**1**
Number of occupants:	**8 (Design)**
Occupant density:	**825.4** ft²/Person

Boundary conditions

Climate:	**VA - WASHINGTON DC REAGAN AP (Monthly)**
Internal heat gains:	**0.7** Btu/hr ft²
Interior temperature:	**68** °F
Overheat temperature:	**77** °F

Building geometry

Enclosed volume:	**94,026.9** ft³
Net-volume:	**63,474** ft³
Total area envelope:	**14,794.2** ft²
Area/Volume Ratio:	**0.2** 1/ft
Floor area:	**6,603** ft²
Envelope area/cFA:	**2.241**

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: **PHIUS+ 2018**

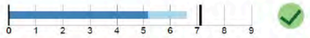
Heating demand

specific:	**4.51** kBtu/ft²yr
target:	**4.6** kBtu/ft²yr
total:	29,766.71 kBtu/yr



Cooling demand

sensible:	**5.17** kBtu/ft²yr
latent:	**1.46** kBtu/ft²yr
specific:	**6.62** kBtu/ft²yr
target:	**7.1** kBtu/ft²yr
total:	43,732.03 kBtu/yr



Heating load

specific:	**3.51** Btu/hr ft²
target:	**4** Btu/hr ft²
total:	23,182.11 Btu/hr



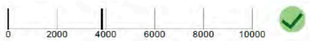
Cooling load

specific:	**2.84** Btu/hr ft²
target:	**2.9** Btu/hr ft²
total:	18,772.36 Btu/hr



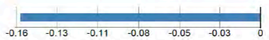
Source energy

total:	**0** kWh/yr
specific:	**0** kWh/Person yr
target:	**3,840** kWh/Person yr
total:	**0** kBtu/yr
specific:	0 kBtu/ft²yr



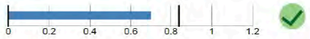
Site energy

total:	-1,037.67 kBtu/yr
specific:	-0.16 kBtu/ft²yr
total:	-304.14 kWh/yr
specific:	-0.05 kWh/ft²



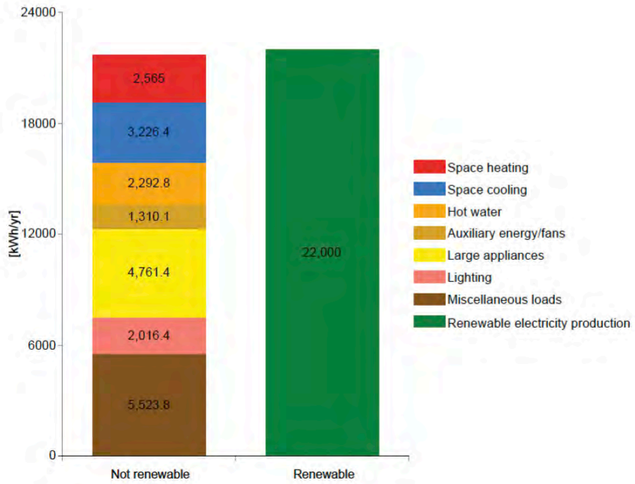
Air tightness

ACH50:	**0.7** 1/hr
CFM50 per envelope area:	**0.05** cfm/ft²
target:	**0.84** 1/hr
target CFM50:	**0.06** cfm/ft²



Project name	**Base**
Climate	**VA - WASHINGTON DC REAGAN AP (Monthly)**
Type	**Residential**
Interior conditioned floor area	**6,603** ft²
Number of units	**1**
Occupants	**8**
Site energy use	**-1,037.7** kBtu/yr
Specific site energy use	**-0.2** kBtu/ft²yr
Site energy use	**-304.1** kWh/yr
Specific site energy use	**0** kWh/ft²yr
Site energy use per person	**-38** kWh/Person yr
Net site energy use (with 100% renewables)	**-1,037.7** kBtu/yr
Specific net site energy use (with 100% renewables)	**-0.2** kBtu/ft²yr
Net site energy use (with 100% renewables)	**-304.1** kWh/yr
Specific net site energy use (with 100% renewables)	**0** kWh/ft²yr
Net site energy use per person (with 100% renewables)	**-38** kWh/Person yr

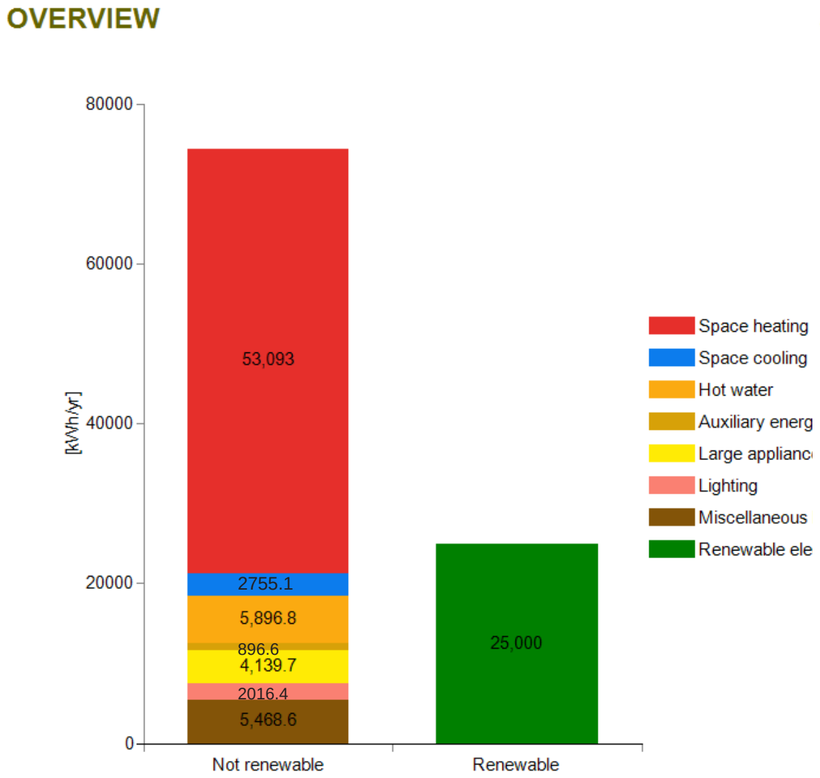
OVERVIEW



Code vs Passive Building

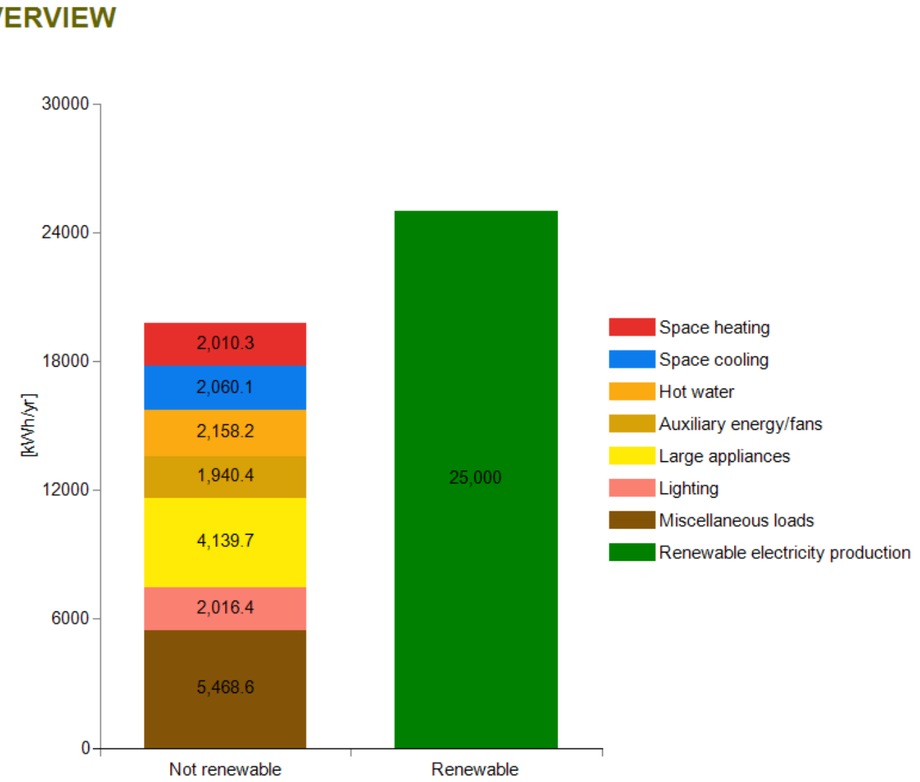
Code (IECC 2018)

Site EUI = 32.86 kBtu/sf



Passive Building

Site EUI = 8.76 kBtu/sf



Del Ray House

peabody | fine architects

8

It's not just 5 principles







LESSON 2:

The Team

(get your whole team involved from the beginning)

PROJECT TEAM

ARCHITECT
CEDAR ARCHITECTURE

LANDSCAPE ARCHITECT
LANDSCAPE ARCHITECTURE BUREAU (MKSK)

MECHANICAL, STRUCTURAL, PLUMBING ENGINEER
MAGRANN ASSOCIATES

STRUCTURAL ENGINEER
APAC ENGINEERING

PASSIVE HOUSE CONSULTANT
PEOBODY FINE ARCHITECTS

INTERIORS
MADIGAN | SCHULER

CIVIL ENGINEER
RC FIELDS & ASSOCIATES, INC

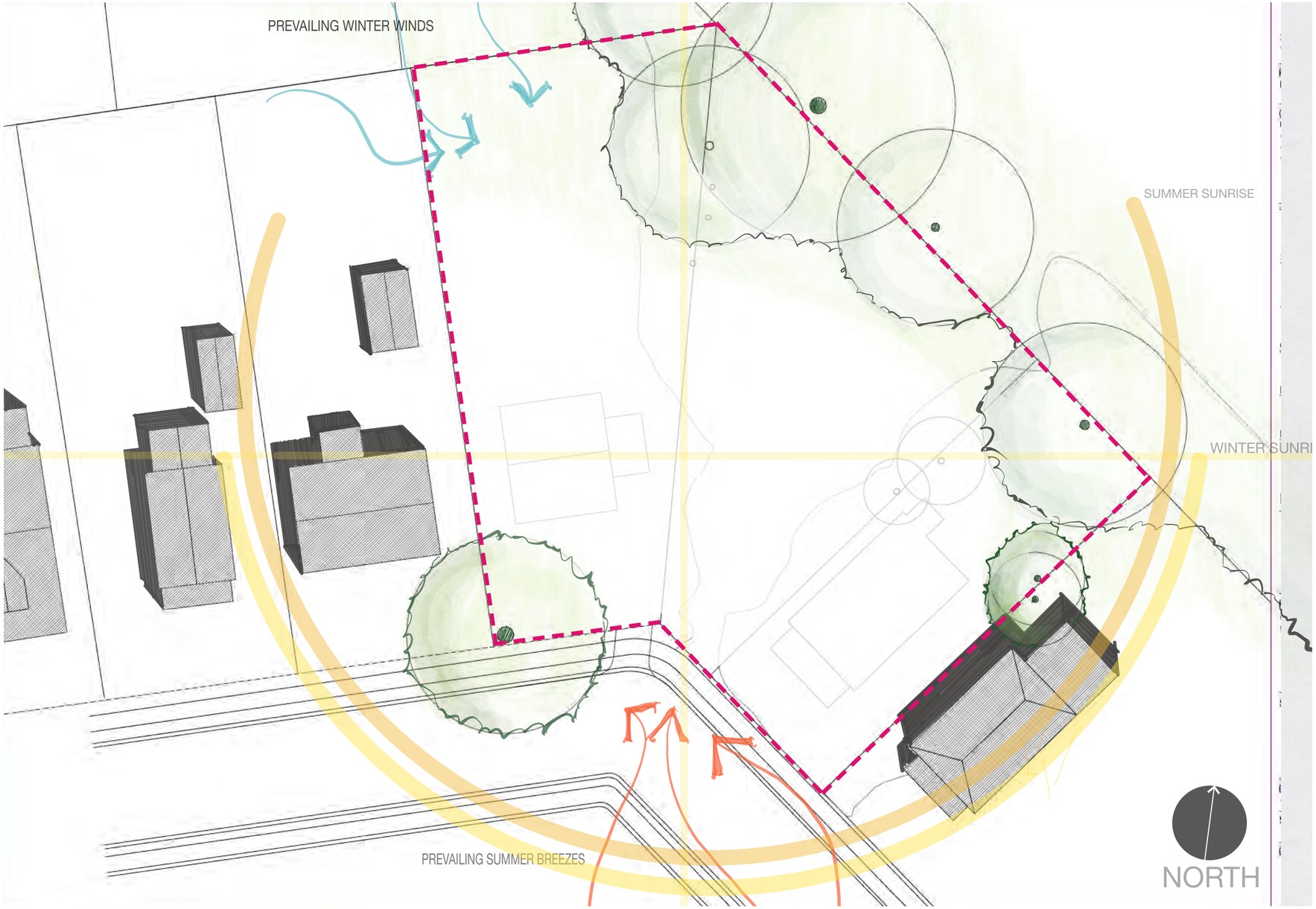
GEOTECHNICAL ENGINEER
GEOTECH ENGINEERS

CONSTRUCTION
THORSEN CONSTRUCTION

LESSON 3:

the site is The Site

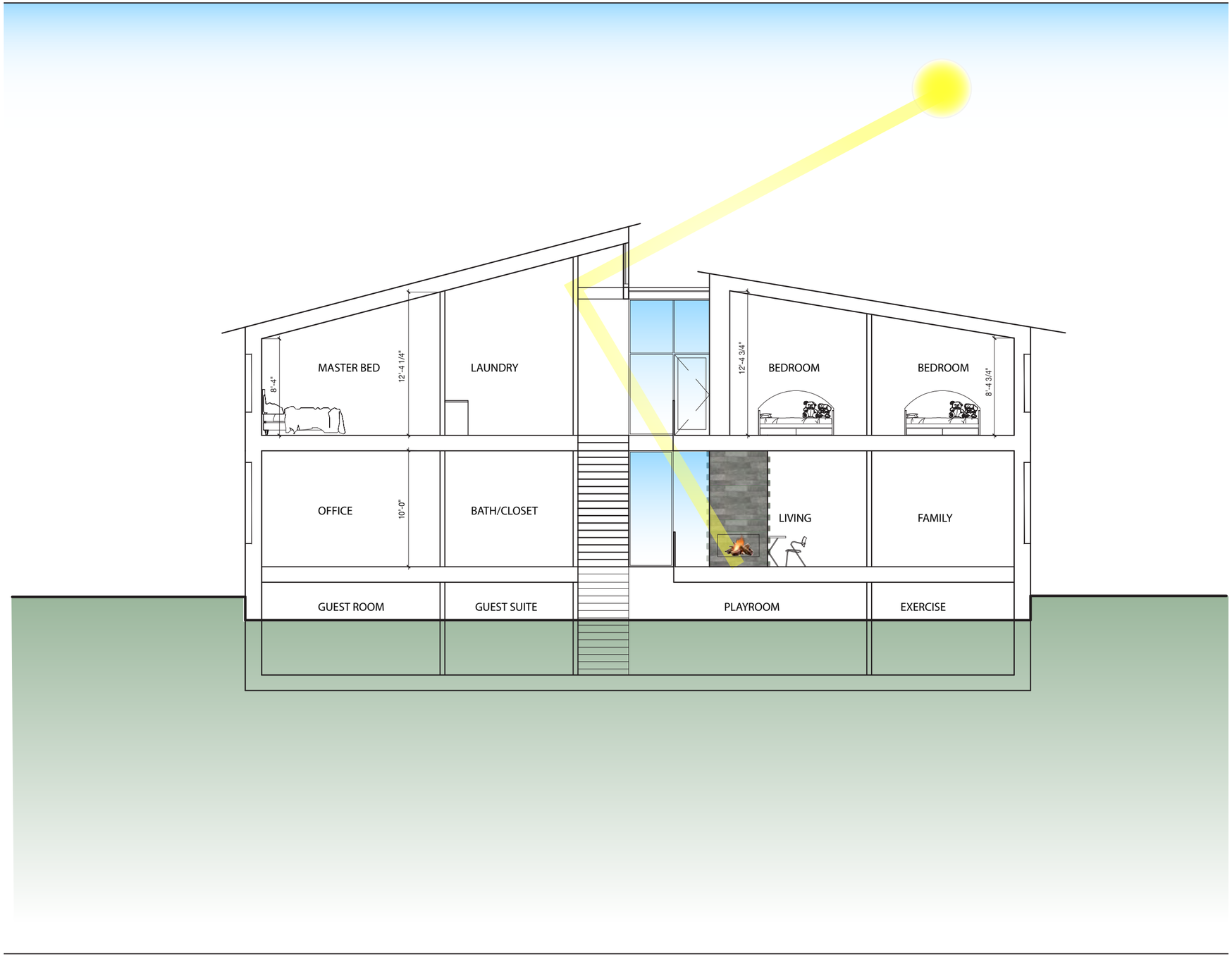
(and the brief is the brief)



EXISTING CONDITIONS


PREVAILING WINTER WINDS
SUMMER SUNRISE
WINTER SUNRI
PREVAILING SUMMER BREEZES
NORTH
2 | LANDSCAPE ARCHITECTURE BUREAU

SITE PLAN

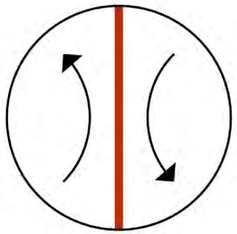

MASTER BED
8'-4"
12'-4 1/4"
LAUNDRY
12'-4 3/4"
BEDROOM
BEDROOM
8'-4 3/4"
OFFICE
10'-0"
BATH/CLOSET
LIVING
FAMILY
GUEST ROOM
GUEST SUITE
PLAYROOM
EXERCISE

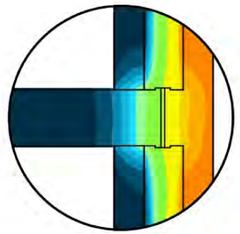
LESSON 4: Air Barriers

continuous insulation

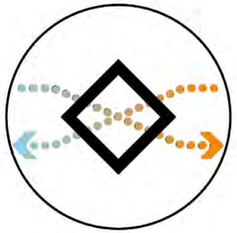


continuous air barrier

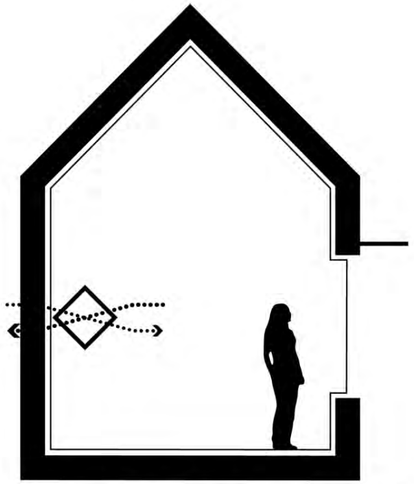


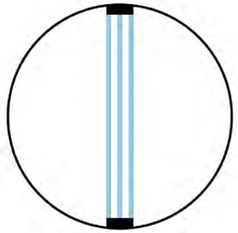


no thermal bridging



fresh air recovery

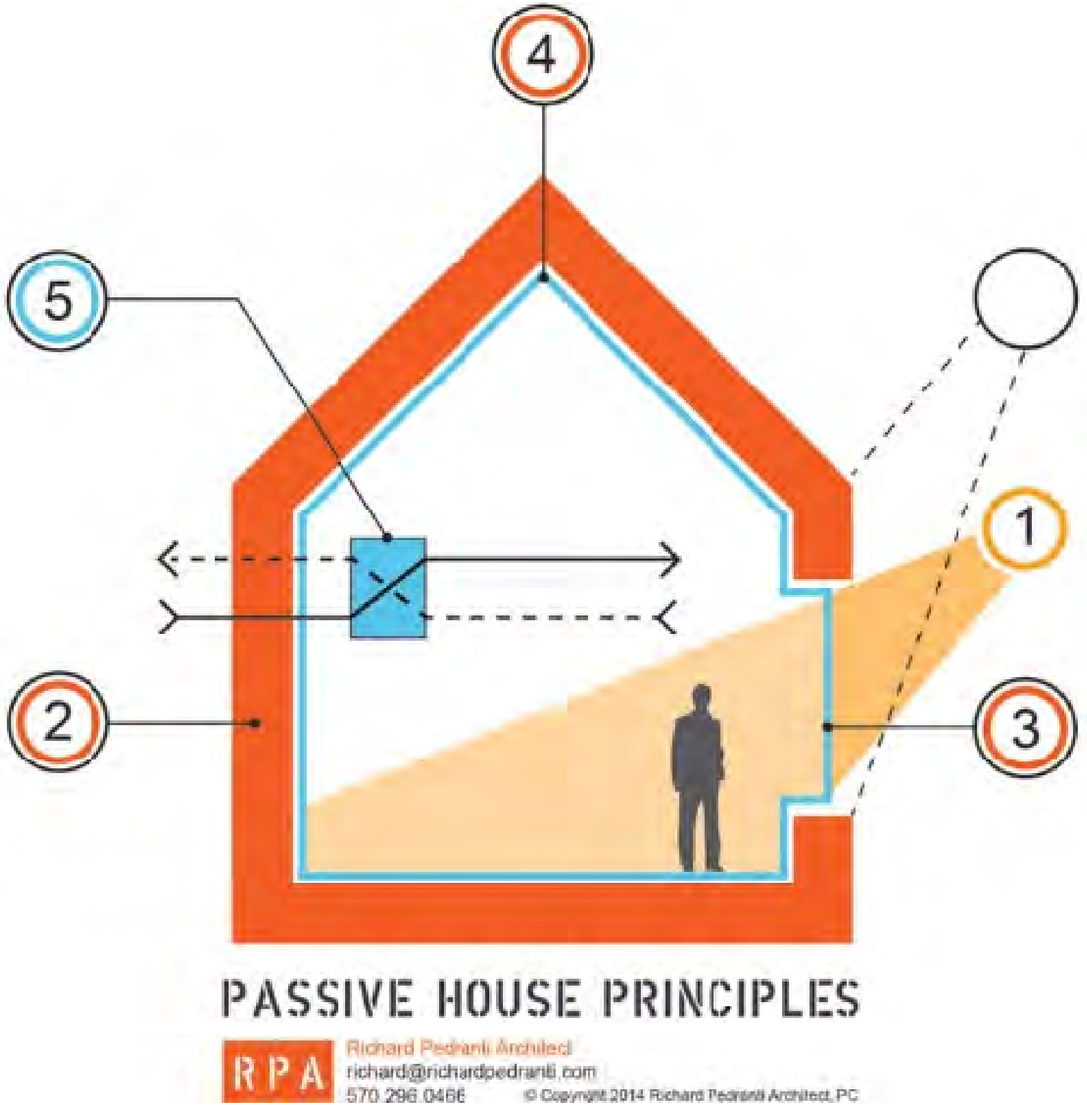




high performance
windows / doors

FIVE PASSIVE HOUSE DESIGN PRINCIPLES

Creative Commons
PassiveHouseAccelerator.com



where does the air barrier go?

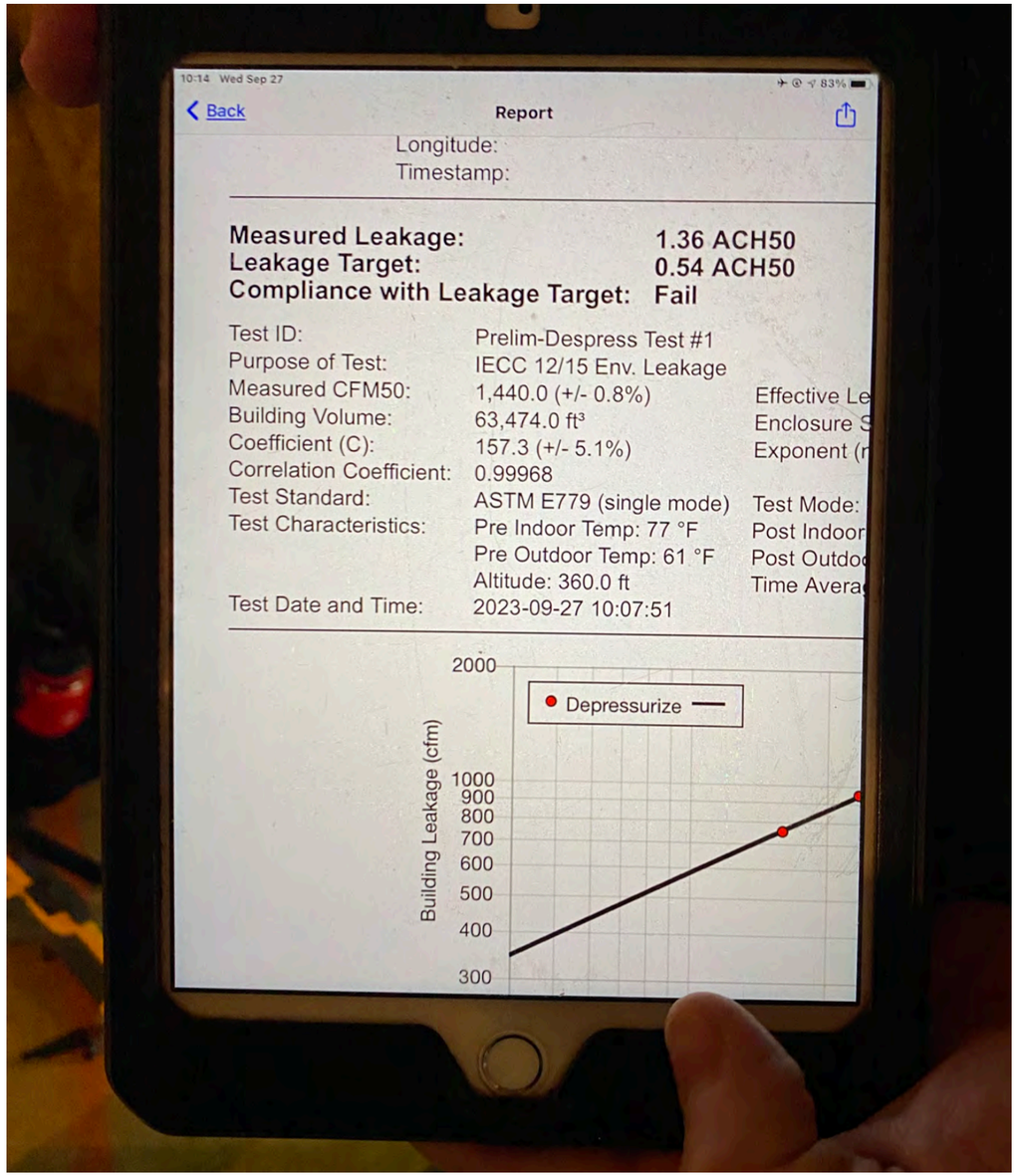

ZIPSystem


ZIPSystem
STRUCTURAL 1
7/16" STRUCTURAL 1 PANEL
STRUCTURAL 1
7/16" ROOF AND WALL SHEATHING





blower door test #1: a spectacular failure





blower door test #2: much better, but still so far....



aeroseal ENVELOPE

ENVELOPE SEALING REPORT

Envelope Sealing Performed For:

Cohen, Thorsen
214 East Randolph Ave
Alexandria, VA 22301

AEROBARRIER CASE ID: 8262

HARDWARE: AeroBarrier Connect

DATE:
10/9/2023

BUILDING TYPE:
Single Family Detached

Envelope Sealing Results:

BEFORE SERVICE

1270.0 CFM of Leakage, equivalent to a
152.9 Square Inch Hole, or
1.20 Air Changes per Hour

(for your 6603-ft² structure
enclosing a volume of 63474 cubic feet)

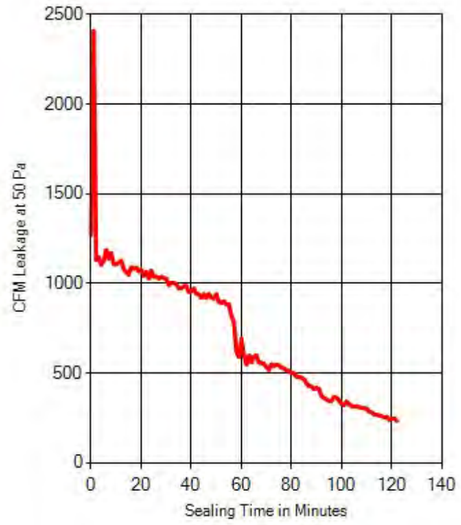
AFTER SERVICE

232.1 CFM of Leakage, equivalent to a
27.9 Square Inch Hole, or
0.22 Air Changes per Hour

This corresponds to a
81.7% Reduction in Envelope Leakage

NOTE: Envelope leakage and air-change results are calculated at a standard pressure of 50 Pa.
Sealing time elapsed: 3:03:48

Envelope Sealing Progress:



Envelope Sealing Performed By:

MID-ATLANTIC AEROBARRIER
BREAKTHROUGH ENVELOPE SEALING TECHNOLOGY

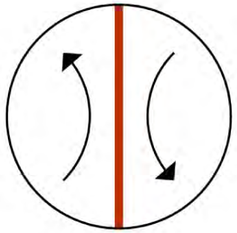
Mid Atlantic AeroBarrier
4701 Sangamore Rd #S125
Bethesda, MD 20816
Phone: (301) 229-7628

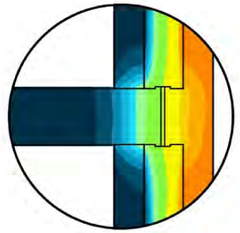
LESSON 5: Insulation Installation

continuous insulation



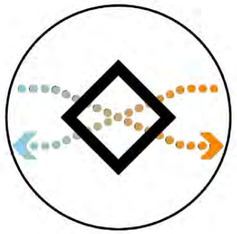
continuous air barrier

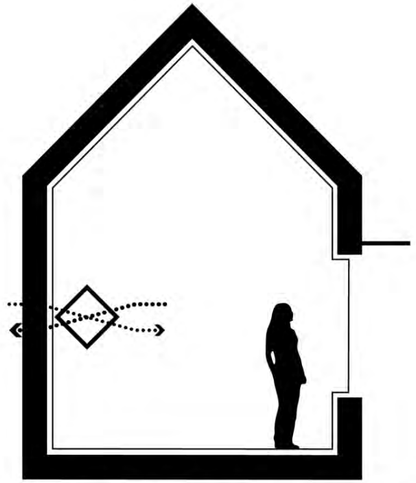


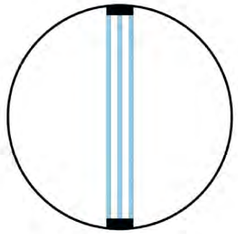


no thermal bridging

fresh air recovery







high performance
windows / doors

FIVE PASSIVE HOUSE DESIGN PRINCIPLES

Creative Commons
PassiveHouseAccelerator.com

Size:	**6,600 (interior conditioned floor area), 7,700 sf (gross area)**	
Slab:	**4" Concrete w/ 6" XPS below**	**R-30**
Foundation Wall (House):	**10" Concrete w/ 4" Mineral wool outside,**	
	2" XPS inside + 2x6 w/ Fiberglass cavity insulation	**R-47**
Foundation Wall: (Crawl Space):	**10" Concrete w/ 4" Mineral wool outside, 2" XPS inside**	**R-47**
Wall:	**2x6 and 2x4 double studs w/ 4" Mineral wool outside,**	
	Fiberglass cavity insulation	**R-49**
Roof (Sloped):	**16" TJI w/ 6" GPS above and densepack cellulose cavity insulation**	**R-90**
Roof (Flat):	**11 7/8" TJI w/ 6" GPS above and densepack cellulose cavity insulation**	**R-75**
Windows:	**Triple glazed – Lowen Ug = 0.13, Uf = 0.2, SHGC = 0.37**	**R-5.3**
Airtight Layer:	**Outside face of sheathing**	
Ventilation:	**ERV - Zehder**	
Heating/Cooling:	**Geothermal Heat pump – Waterfurnace**	
Hot Water:	**Heat pump hot water heater – Rheem**	
Airtightness (Target):	**0.56 ACH50 (0.04 cfm/sf)**	



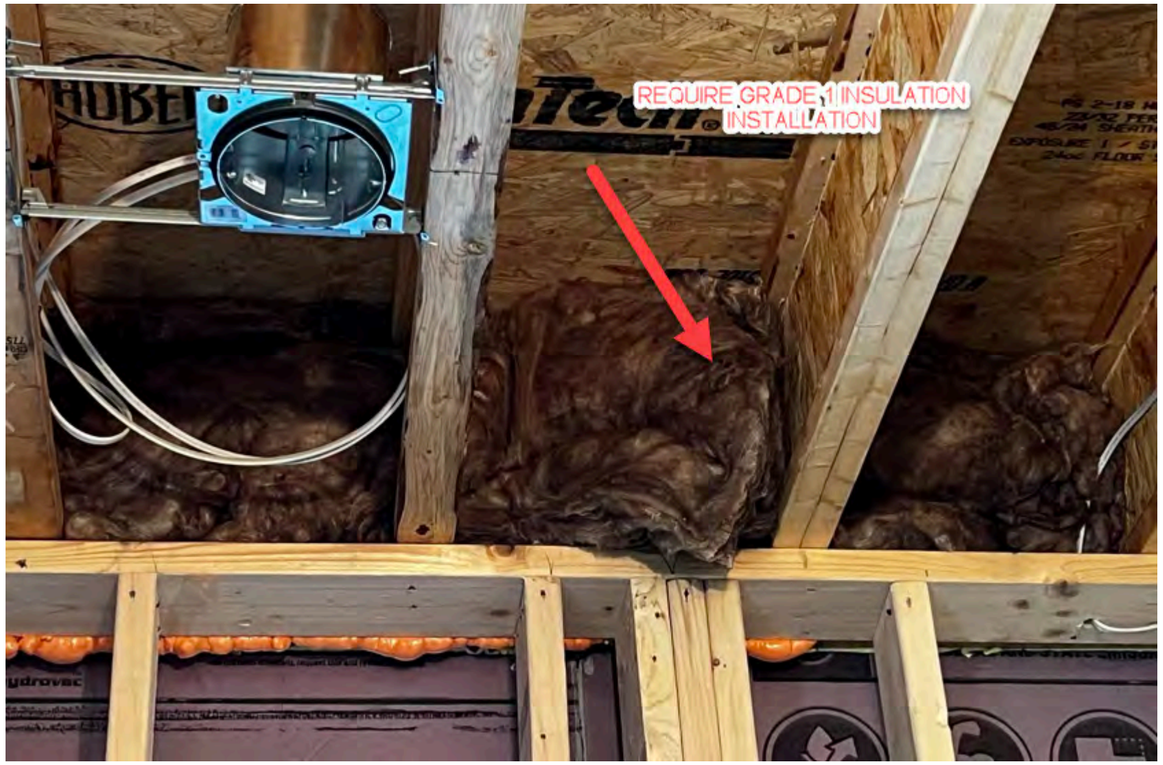



22¾"

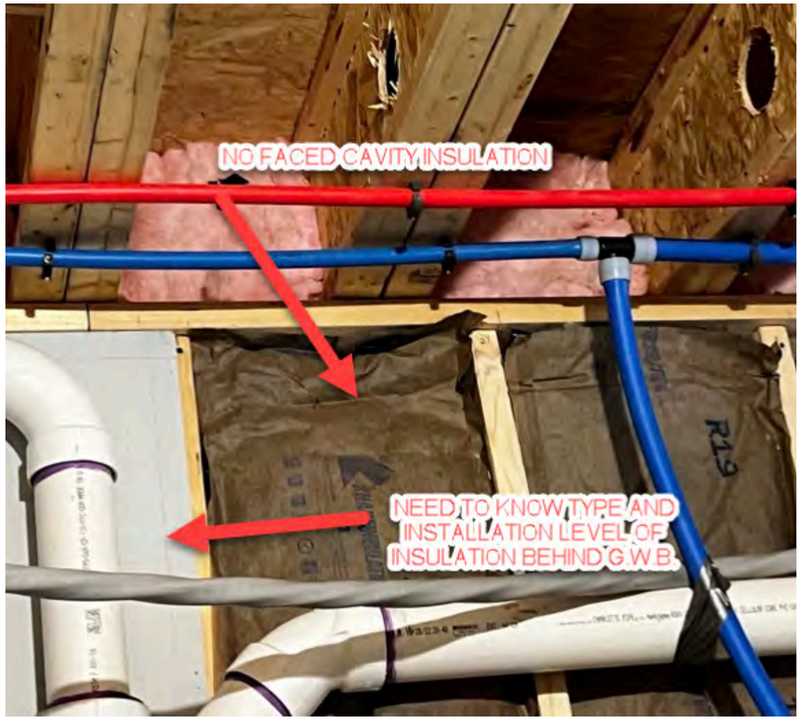



BIO RETENTION
GARDEN


FILL WITH BLOW-IN CELLULOSE


REQUIRE GRADE 1 INSULATION INSTALLATION


FILL WITH INSULATION BEHIND BLOCKINGS


NO FACED CAVITY INSULATION
NEED TO KNOW TYPE AND INSTALLATION LEVEL OF INSULATION BEHIND G.W.B.

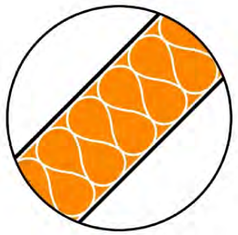




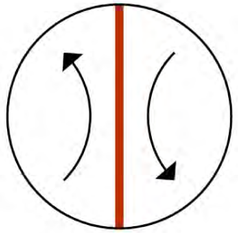
This is more like Level 4 Insulation

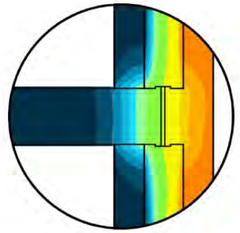
LESSON 6: Thermal Bridging

continuous insulation



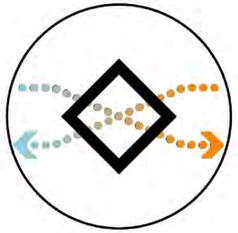
continuous air barrier

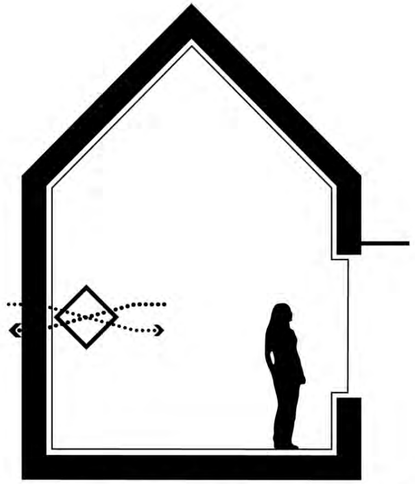


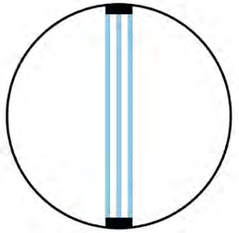


no thermal bridging

fresh air recovery



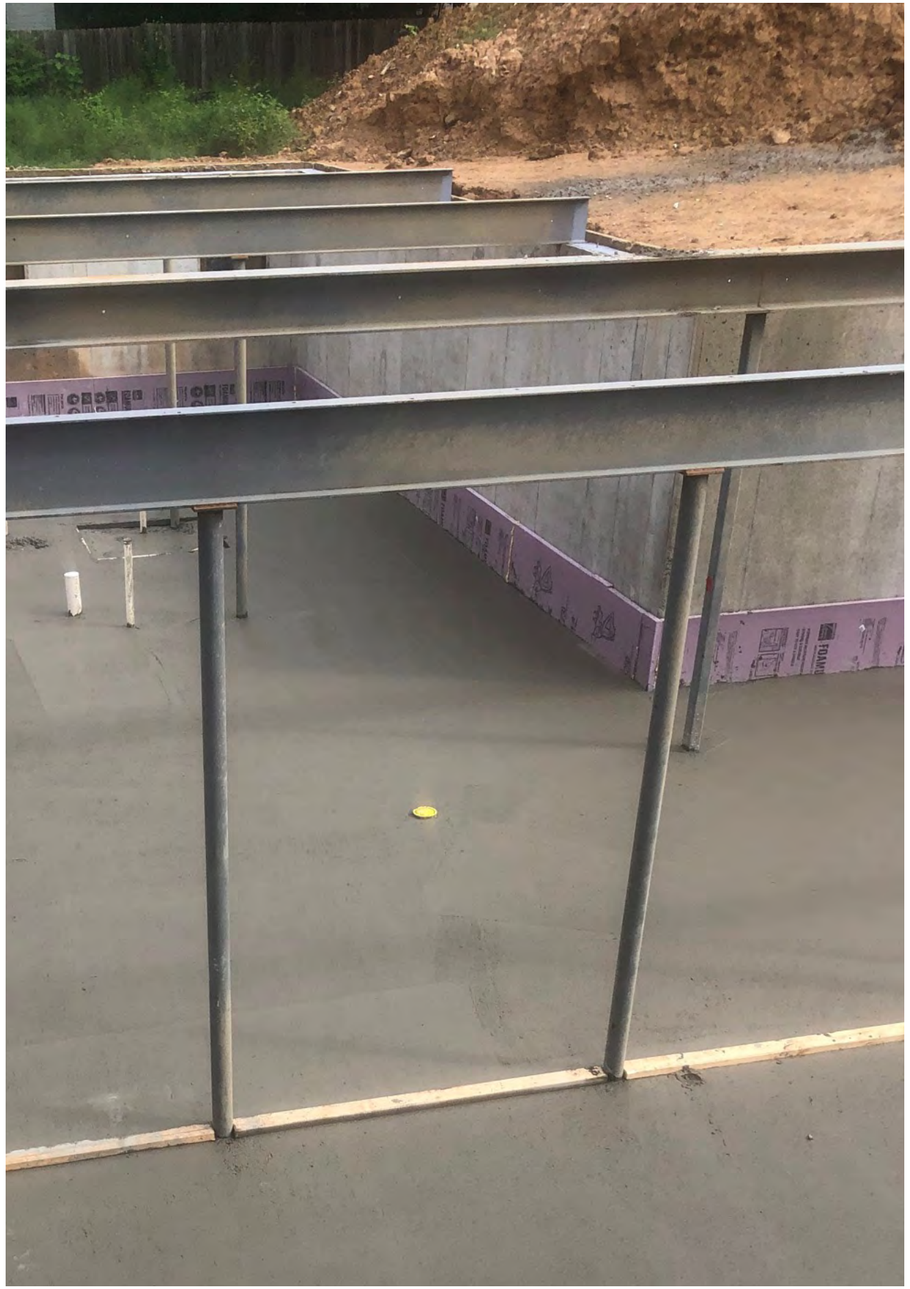




high performance
windows / doors

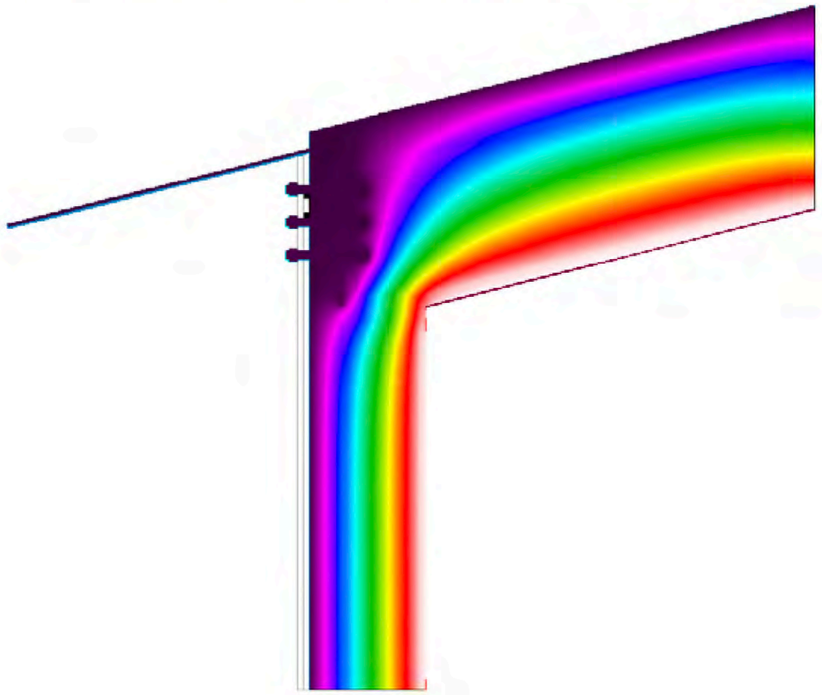
FIVE PASSIVE HOUSE DESIGN PRINCIPLES

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Thermal bridge analysis






REQUIRE THERM
CALCULATION

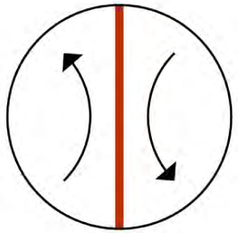

REQUIRE THERM CALCULATION

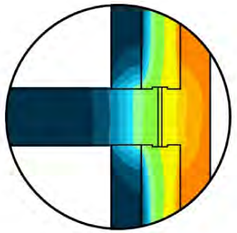
LESSON 8: Window & Doors

continuous insulation



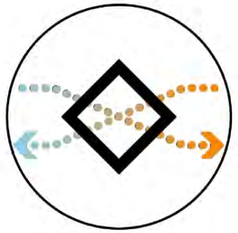
continuous air barrier

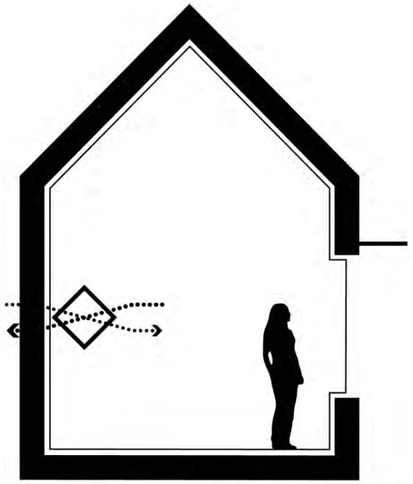


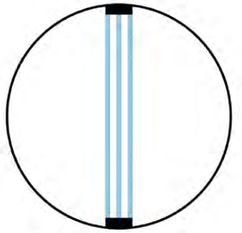


no thermal bridging

fresh air recovery







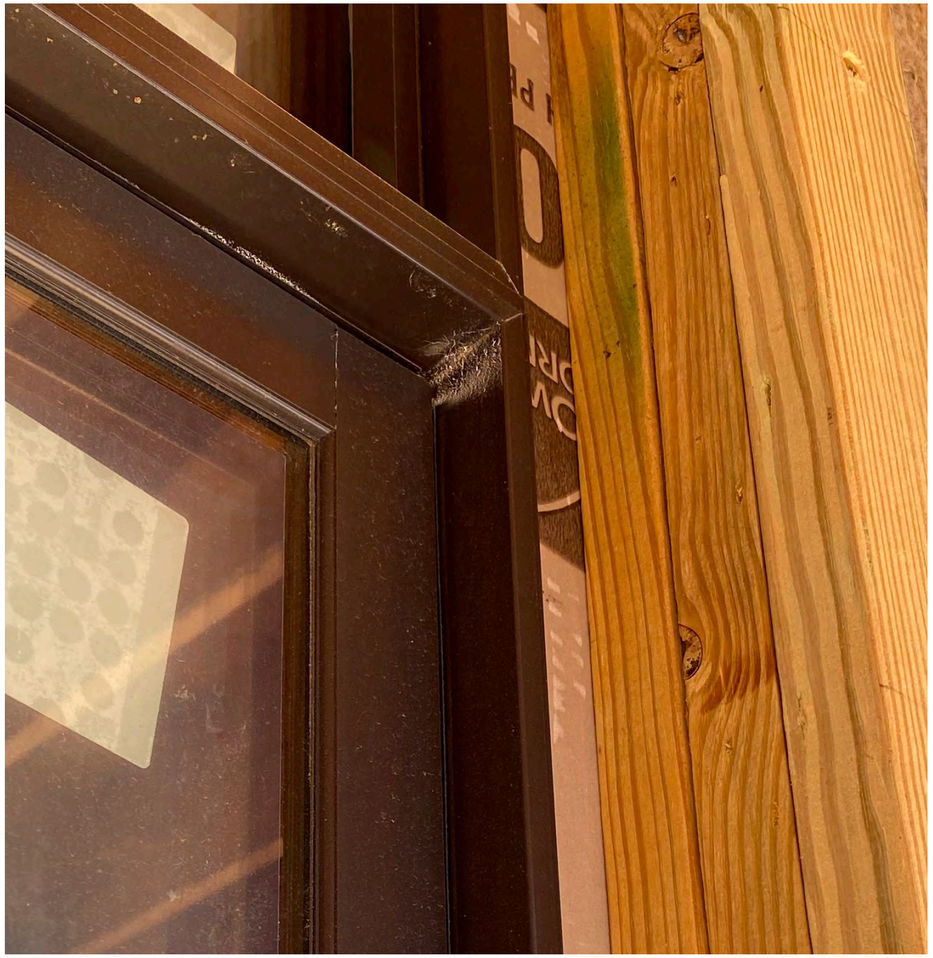
high performance windows / doors

FIVE PASSIVE HOUSE DESIGN PRINCIPLES

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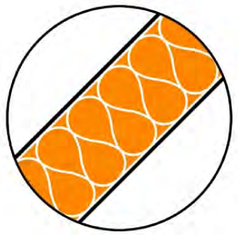

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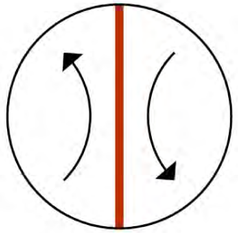


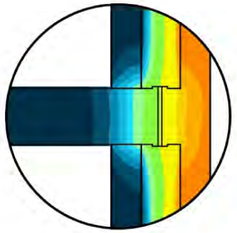
LESSON 8: Balanced Air

continuous insulation



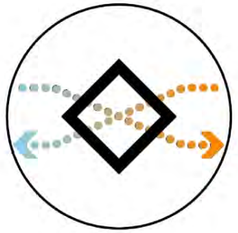
continuous air barrier

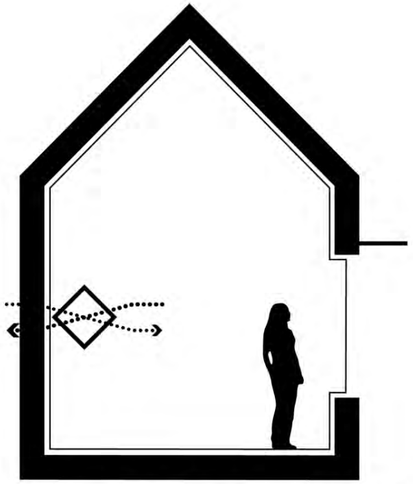


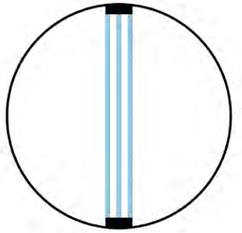


no thermal bridging

fresh air recovery



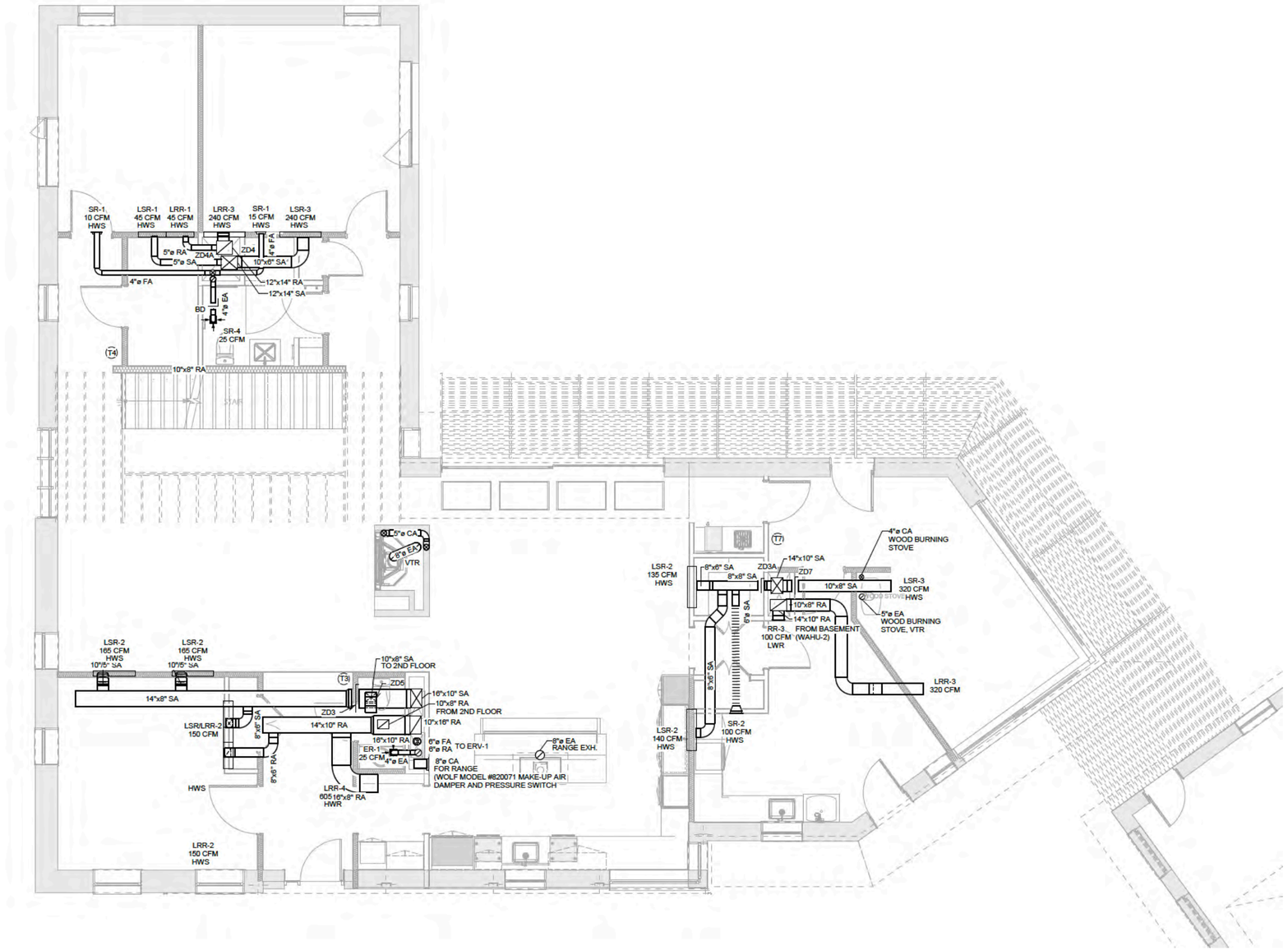




high performance
windows / doors

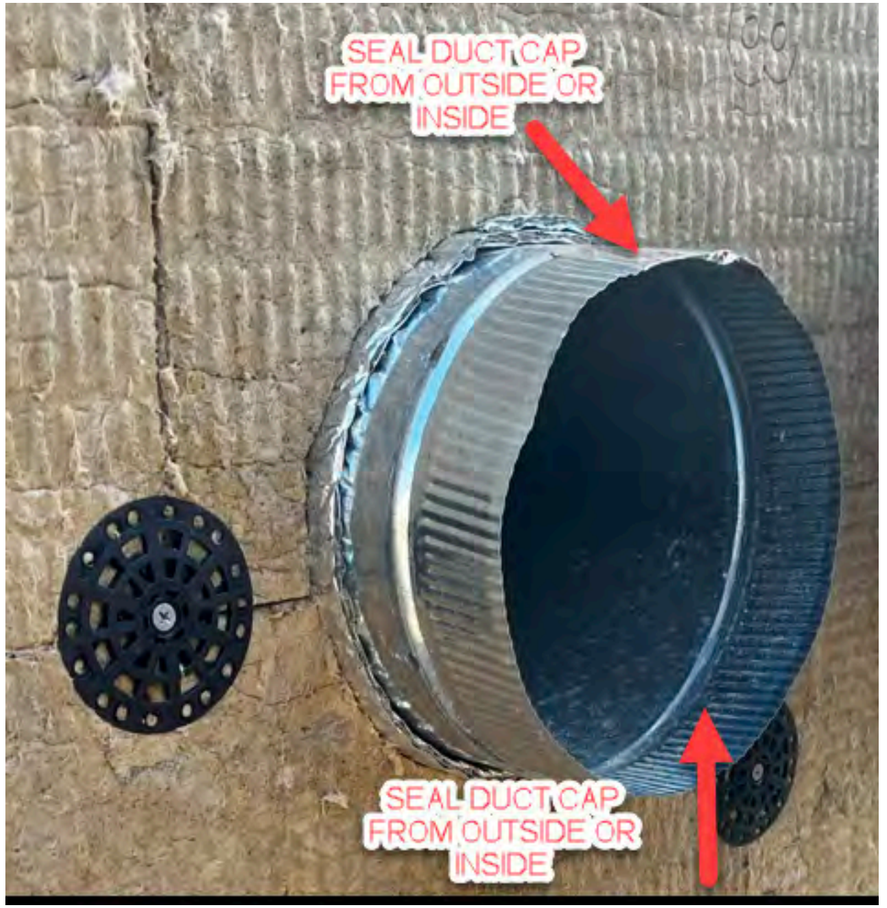
FIVE PASSIVE HOUSE DESIGN PRINCIPLES

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MAIN FLOOR HEATING, COOLING AND ERV DUCTWORK


GAP NEEDS TO BE ADDRESSED


SEAL DUCT CAP
FROM OUTSIDE OR
INSIDE
SEAL DUCT CAP
FROM OUTSIDE OR
INSIDE

LESSON 9: It's a home, Not a spreadsheet



FINAL LESSON:

INTENT is everything

Generosity of Spirit goes a long way


GREAT STUFF
WINDOW & DOOR

THANK YOU

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