

A statewide initiative: The expanding influence of Passive House in South Dakota

Charles MacBride, AIA, Associate Professor SDSU DoArch

Robert Arlt, AIA, CPHC, Instructor SDSU DoArch

A statewide initiative: The expanding influence of Passive House in South Dakota

- **Introduction** PHIUS and SD Initiatives
 - 1 **Prototype Governor's House** and the role of SDHDA
 - 2 **CPHC** sponsored training to AIA South Dakota
 - 3 **Copper Pass** pilot multifamily affordable housing, Sioux Falls SD
 - 4 **PH01:BRK** SDSU student designed single family house, Brookings SD

- 1 **Prototype Governor's House / income-qualified & pre-fab**
- 2 **CPHC sponsored training / professional community**
- 3 **Copper Pass / multifamily affordable housing**
- 4 **PH01:BRK / educating architecture students**

While it isn't an excuse, it is important to remember that design and construction in the region is entrenched in the known. There is little financial or cultural incentive for change or innovation.

1 Prototype Governor's House and the role of the South Dakota Housing Development Authority (SDHDA)



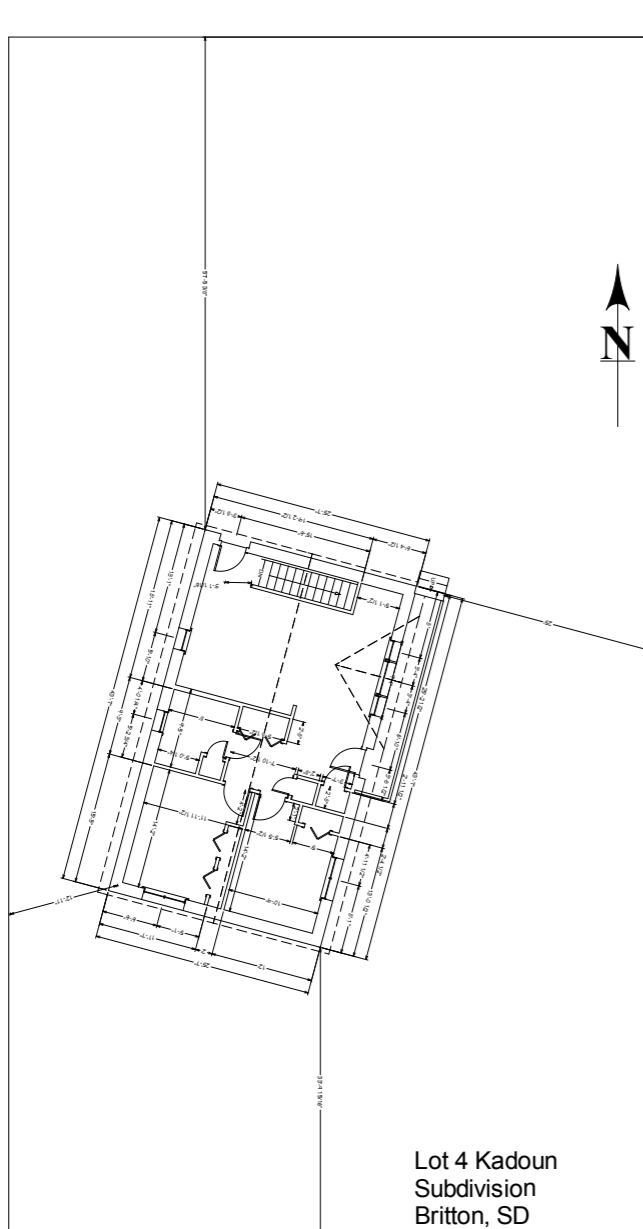
Prototype Governor's House

Design & fabrication 2013

PHPP pre-certification (attempted)

Installed, Britton, SD 2016

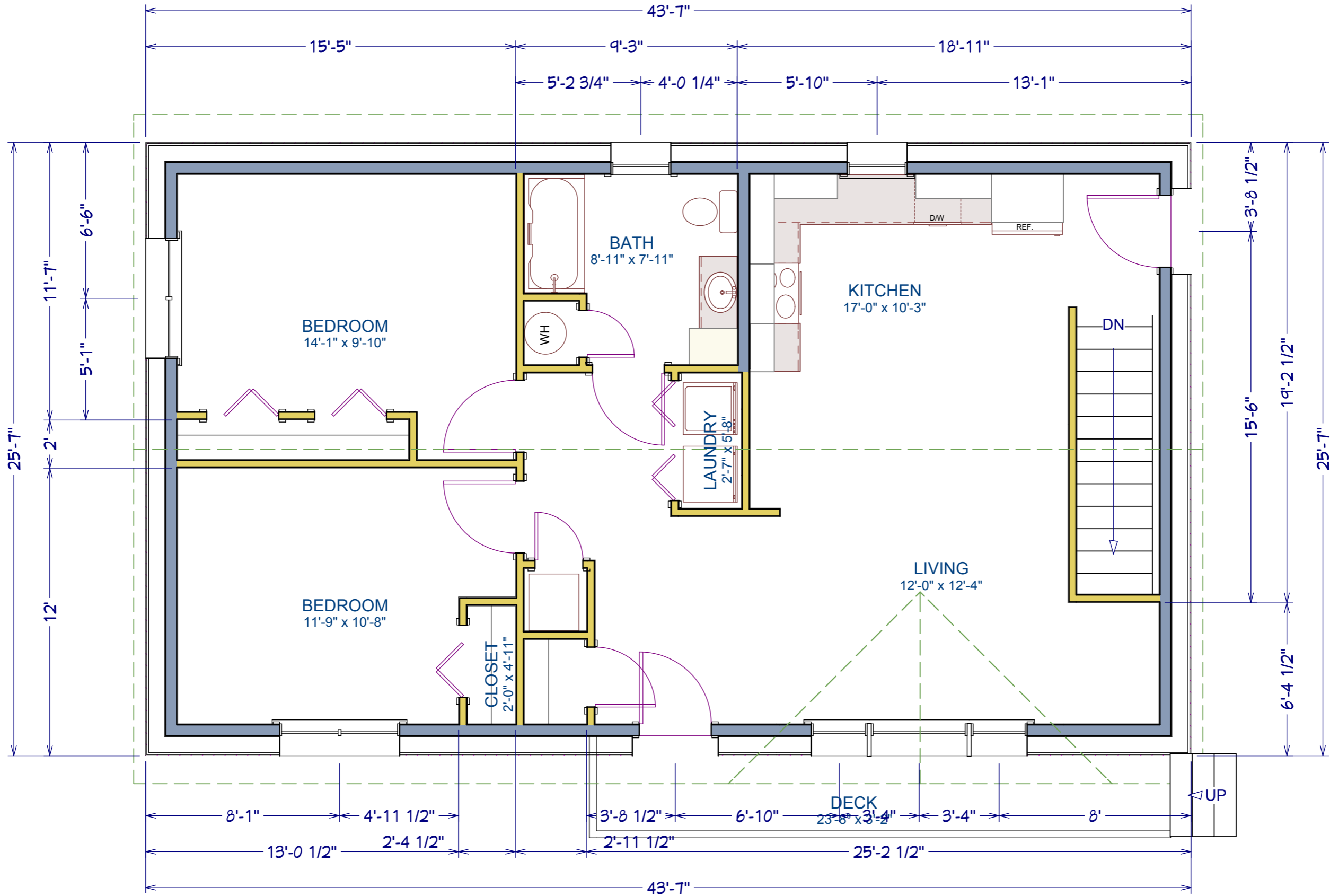
PHIUS+ certification 2017

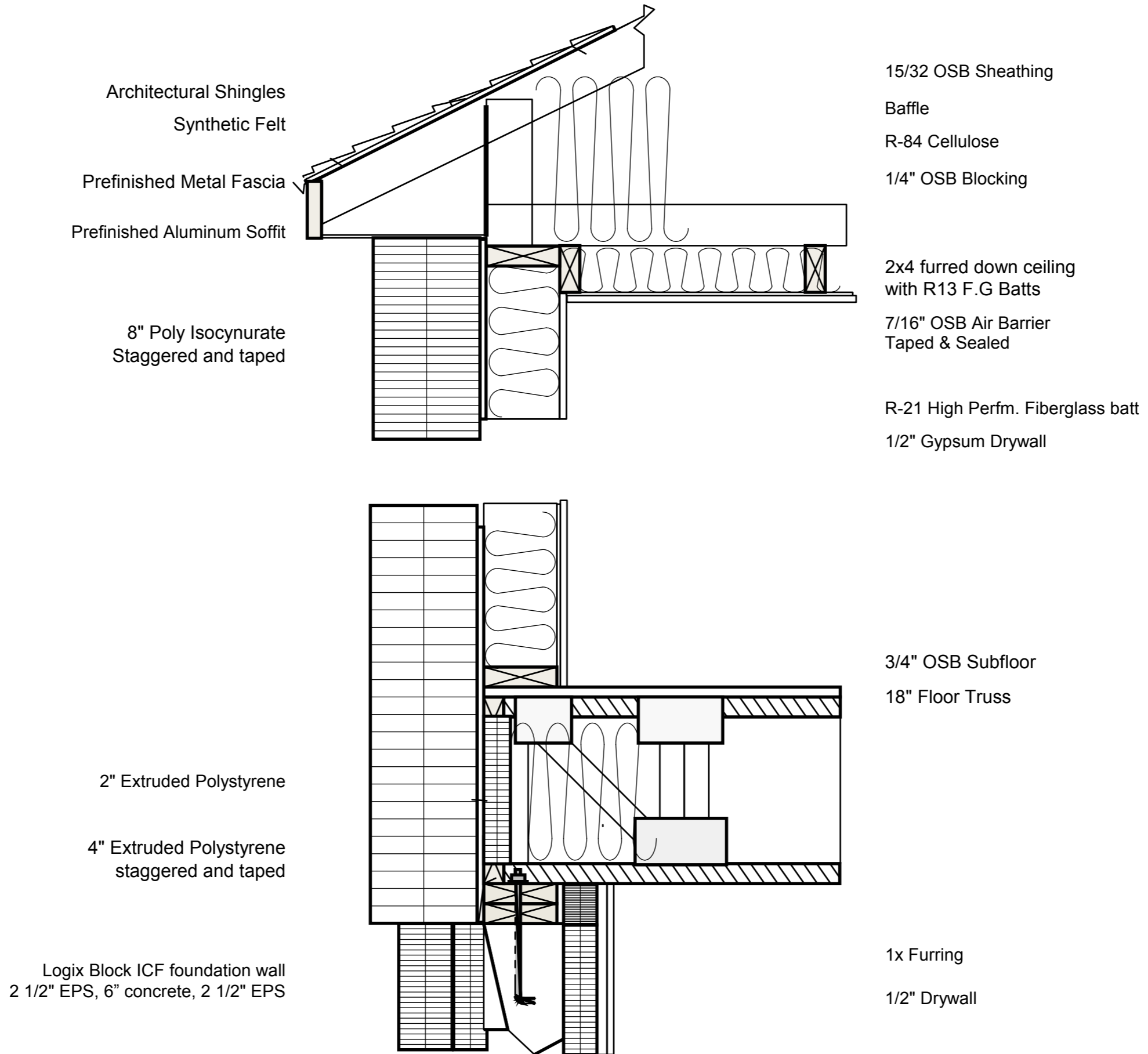


Lot 4 Kadoun
Subdivision
Britton, SD









2 CPHC sponsored training to AIA South Dakota

2016 SDHDA / AIA SD participants:

Patri Acevedo, AIA, CPHC, JLG | AcV2 Architects

Robert Arlt, AIA, CPHC, Instructor SDSU DoArch

Alison Dvorak, AIA, CPHC, Koch Hazard Architects

Andrew Fett, AIA, CPHC, LEED AP, Williams & Associates

Herm Harms, AIA, CPHC, Puetz Corporation

Katie Krantz, AIA, CPHC, VanDeWalle Architects

Jason Roberdeau, AIA, CPHC, Williams & Associates

Other SD CPHC

Mike Harsma, CPHC, Director SDHDA Governors House Program

Aspen Greene, CPHC, Graduate Student SDSU DoArch

Emily Nelsen, CPHC, 2016 Graduate SDSU DoArch

from follow-up interviews:

Descriptions of projects that, for example, call for “a greater air-tightness or thermal envelope than usual, and then are changed ‘back to normal’ in the field” without knowledge of the architect are alarmingly common.

Other examples of municipal reviewers “waiving a nominal energy requirement for the financial benefit of developers and builders” seems standard.

A discussion of various contractor’s own interests and abilities ranged from excellent to unintelligible: one “questioned the entire topic of building science and the usefulness of knowing where the dew point falls in a wall assembly.”

3 **Copper Pass** pilot multifamily affordable housing, Sioux Falls SD



Copper Pass Affordable Housing

Design & construction 2016-18

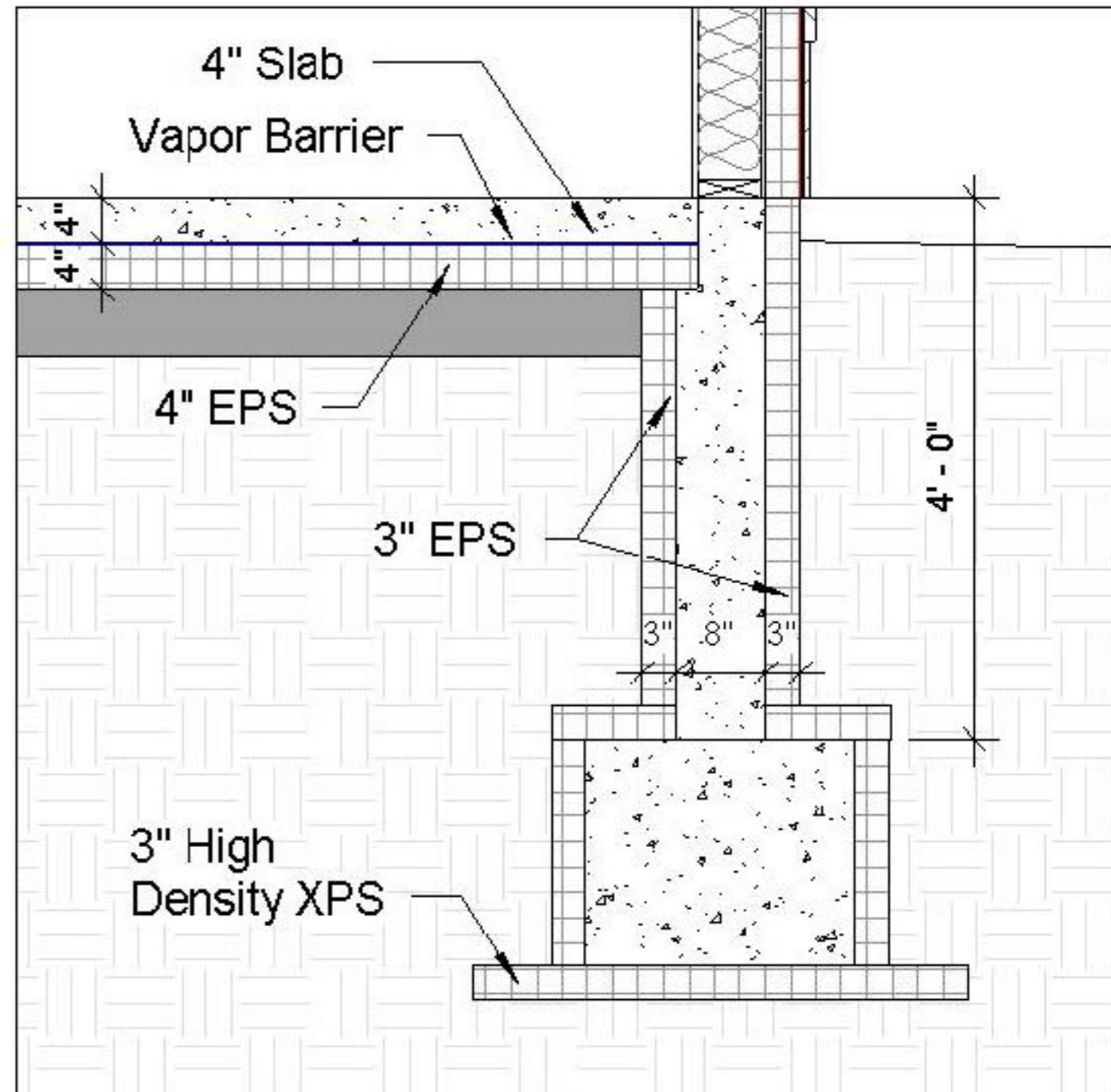
PHIUS+ pre-certification, 2017 (in-progress)

- **SDHDA pilot Passive House affordable housing project**
- **Architect: VanDeWalle Architects LLC**
- **Developer: Costello Co.**
- **General Contractor: BlackWing Elite Builders**
- **Project Goals:**
 - **Achieve Passive House certification**
 - **Build sister project to ENERGY STAR certification**
 - **Compare and analyze construction costs, operating costs, and performance data of both projects**
- **Originally 24 units; added 6 more when costs came in under budget**

Copper Pass Affordable Housing

Footing and Foundation Design

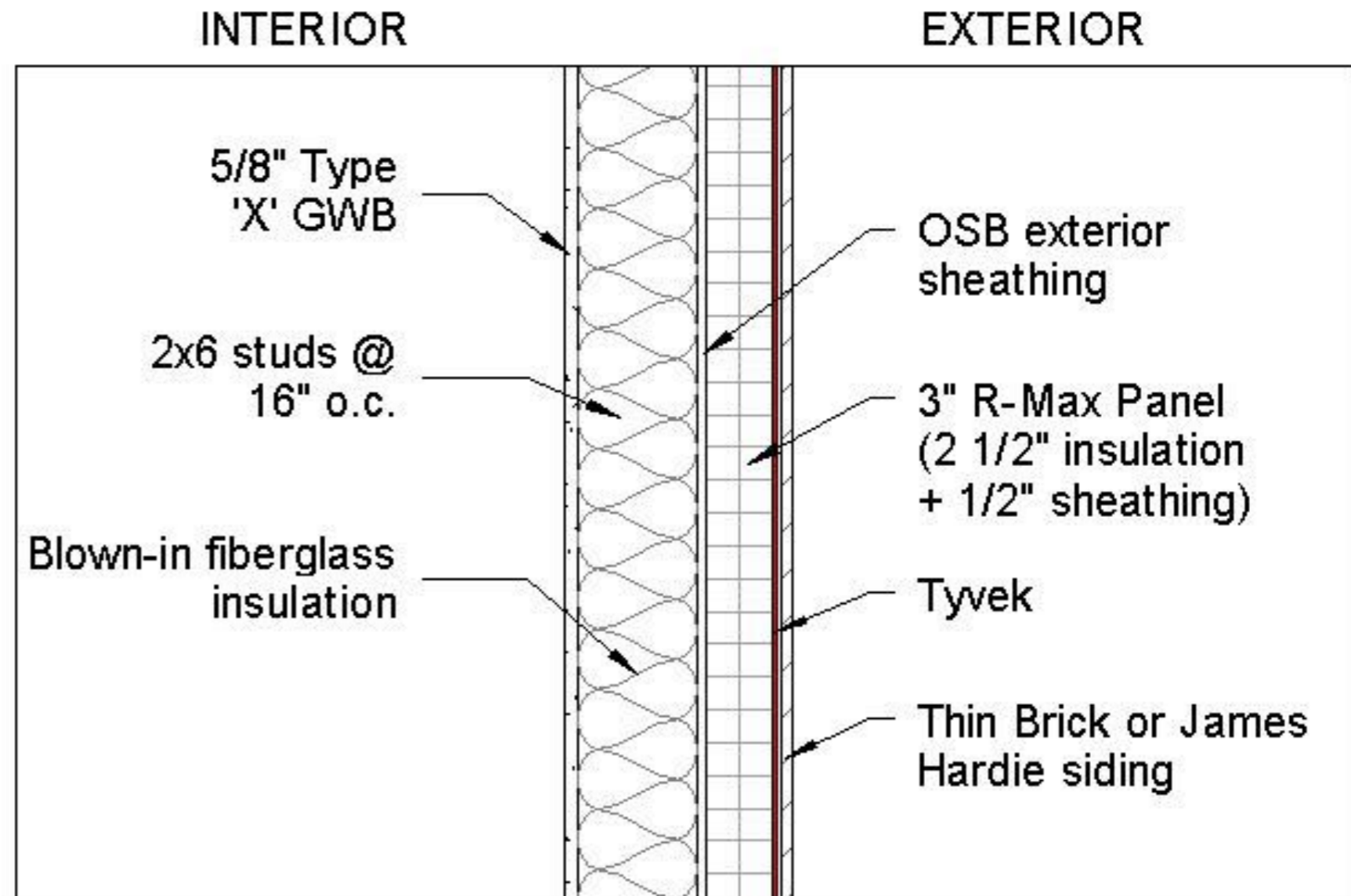
- Wanted to keep it conventional as possible
- Typical spread footing with 4' foundation wall
- 3" of high density XPS under footing
- Entire foundation wall wrapped with 3" of EPS
- 4" of EPS under entire slab



Copper Pass Affordable Housing

Wall Assembly

- Typical 2x6 stud cavity
- R-Max panels for continuous insulation
- Thin Brick & James Hardie siding



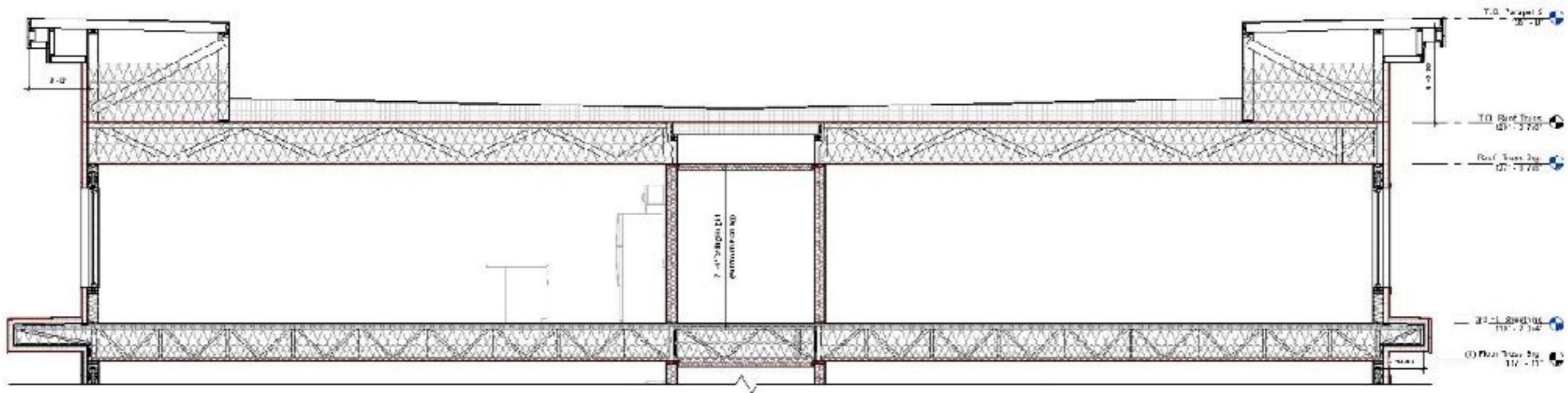
Copper Pass Affordable Housing

Roof & Parapets

- Roof = R-75
- 24" roof trusses, blown full
- SIPs above corridor
- R-49 above roof sheathing
- Boxed parapets outside air barrier
- No ductwork in roof truss cavity

Mechanical System

- Energy Recovery Ventilator – zoned by floor.
- Fresh Air Ducted to each bedroom.
- Filtered Exhaust from kitchens.
- Duct-free Mini-split System – one per apartment.
- Condensing Dryers.
- Low-flow plumbing Fixtures.



Copper Pass Affordable Housing

Footing & Foundation Wall

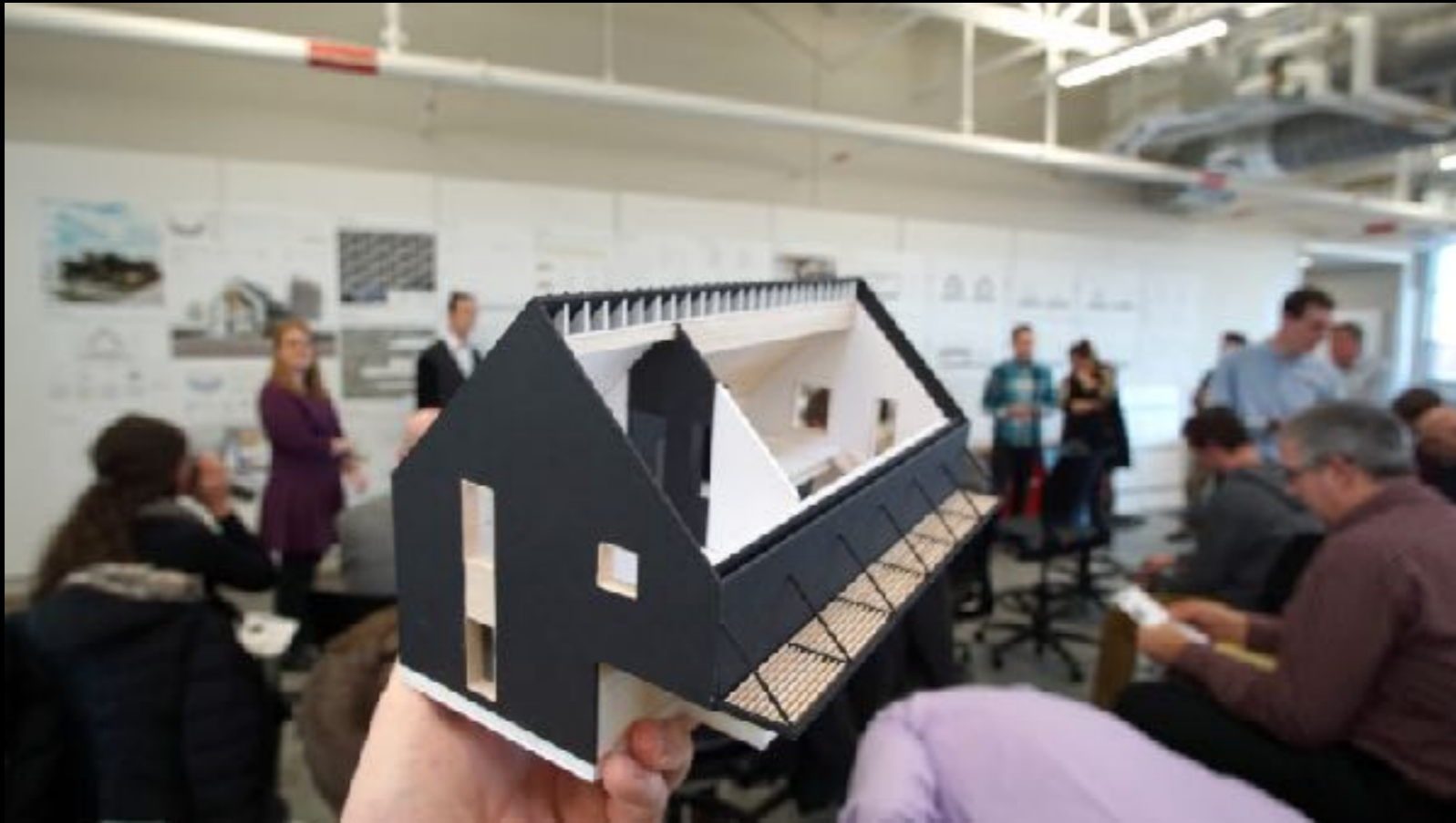


Copper Pass Affordable Housing

Slab Insulation & Vapor Barrier



4 PH01:BRK SDSU student designed single family house, Brookings SD



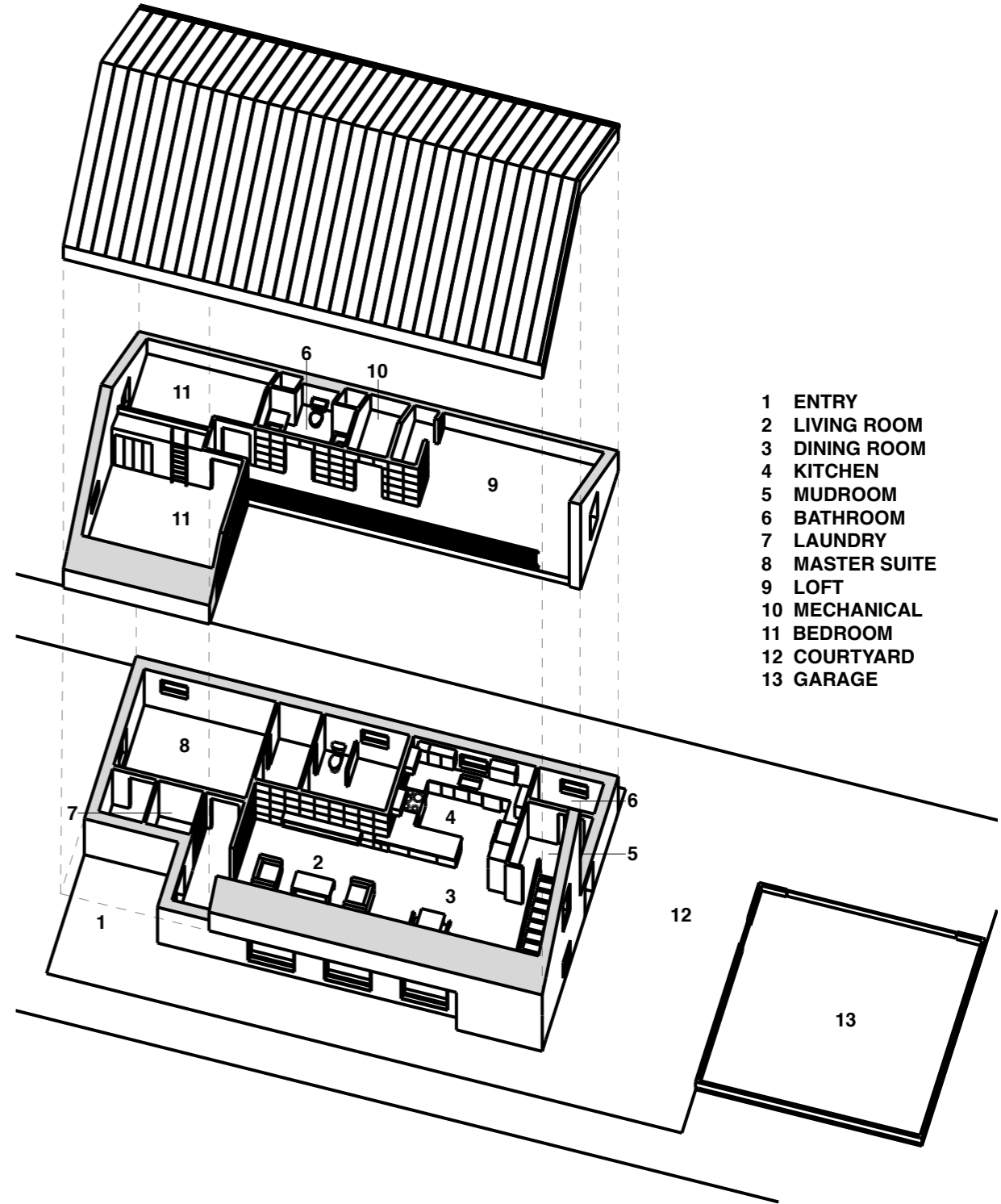
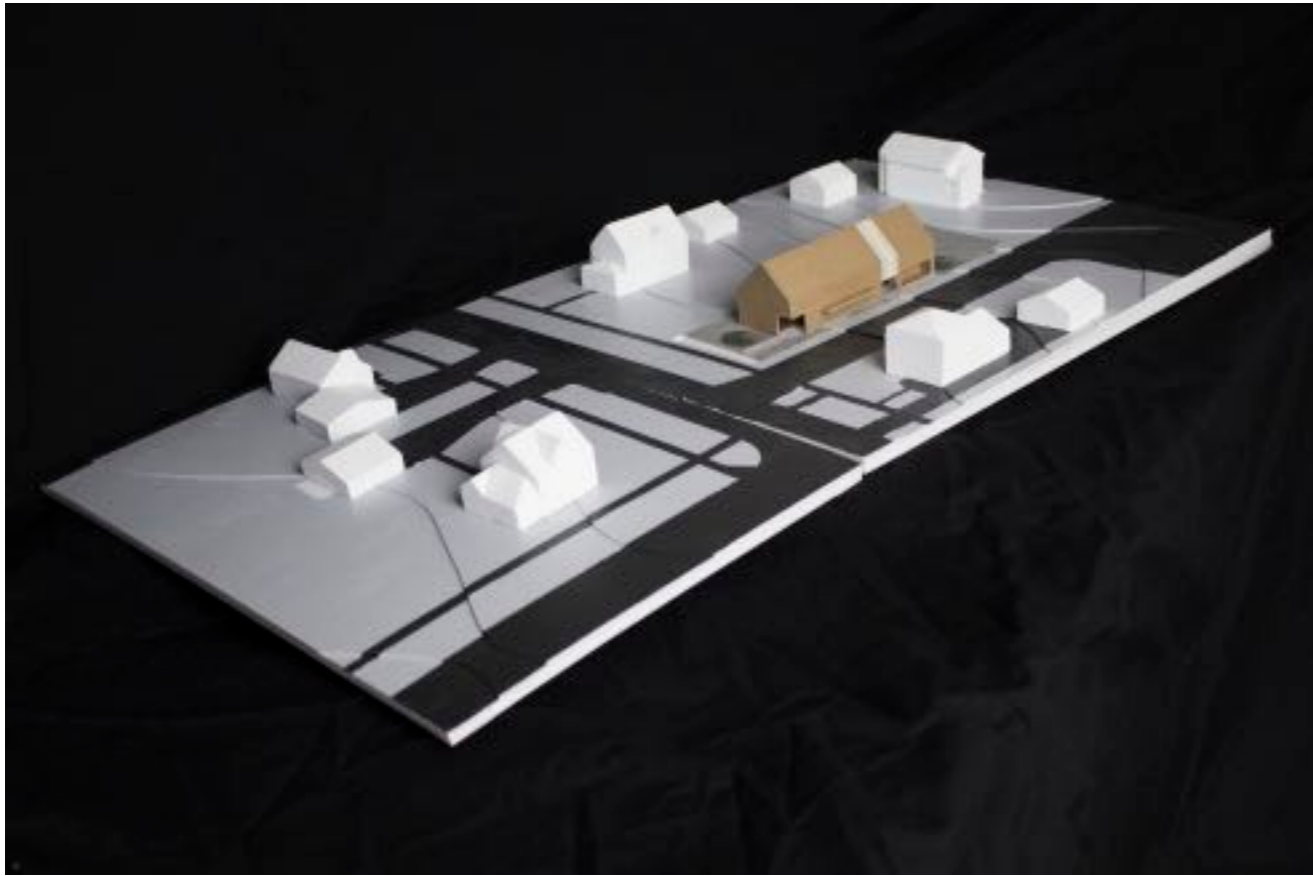
PH01:BRK

Student design, fall 2016

PHIUS+ pre-certification, 2017

Construction, Brookings, SD 2017-18



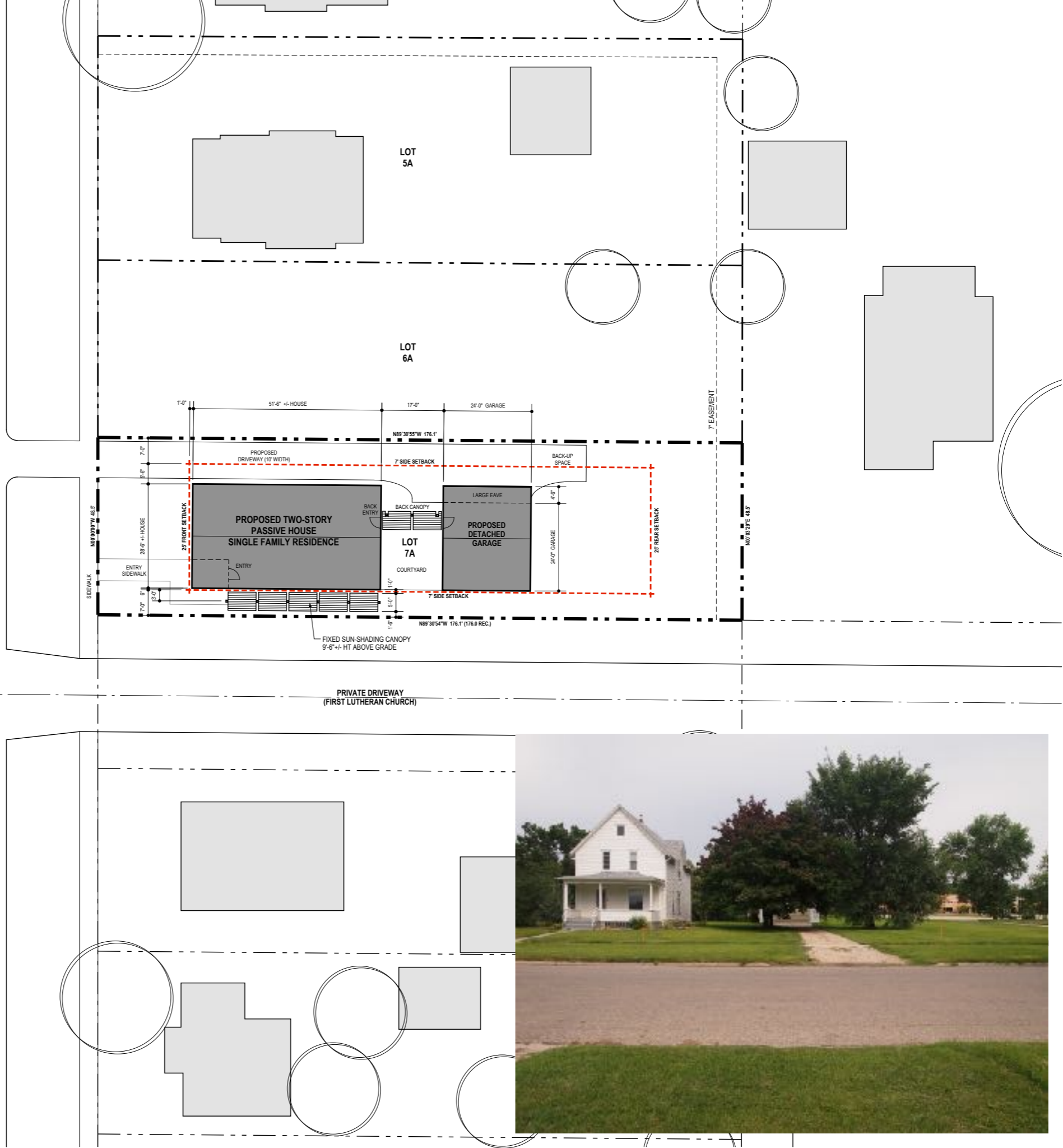




ALLEY

3RD AVENUE

9TH STREET



ENERGY RECOVERY VENTILATION
 Recovers both sensible and latent heat from outgoing (exhaust) air stream by transferring it to the incoming (supply) air stream. Ultimate Air 200DX up to 200 CFM. Appoint schedule. Effectiveness (AE) of 85%. 3rd of 3rd in heating season. 1st of 4th in the cooling season. Pre-heater needed for operating temps below 10 degrees F.

DHW TANK-LESS WATER HEATER
 ECO Smart ECO 35 0.5 KW with 99.9% efficiency. 3.9 CFM unit capacity with 42 degree inlet temp.

MINI SPLIT HEAT PUMP
 LG-LS 9H1S-V4. Ductless Indoor and outdoor condenser. 9000 BTU. HSPF: 10.8. Heating range: Cooling: 14°F DB to 118°F DB. Heating: -1°F WB to 65°F WB.

ROOF ASSEMBLY - R-84
 standing seam, sheathing, 4" EPS foam insulation, sheathing, 24" TJI joist 2x12 @ 24" o.c. filled w/ dense pack cellulose, taped and sealed sheathing (Napor Bomer) interior finish.

DOUBLE HEIGHT VOLUME
 Allows for better airflow throughout the house.

Floor Assembly - R-50
 12 inch EPS foam insulation, long span backfill, 2" concrete, 1/2" sub floor.

WALL ASSEMBLY - R-45
 80 mm Enton, 2.5" insulat free air, 2" EPS foam, 0.75" OSB sheathing taped and sealed, 2x6 framed cavity well fill with 80% mineral wool insulation, interior finish.

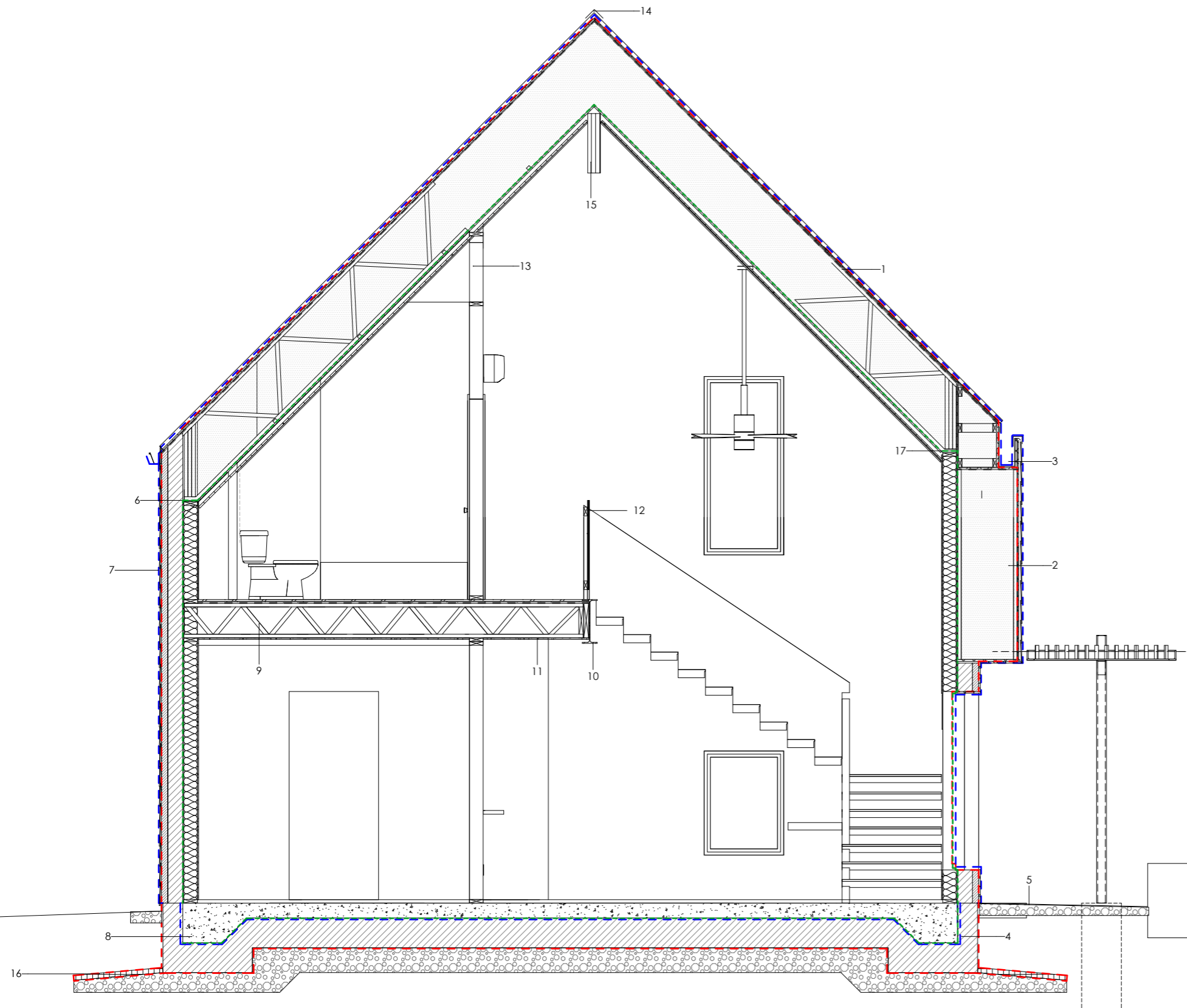
WINDOWS PASSIVE HEATING & COOLING
 Provides heat to enter house in summer for natural ventilation and cooling.

Perfects heat from escaping the house.

Larger south facing windows allow sunlight to warm the house in winter months.

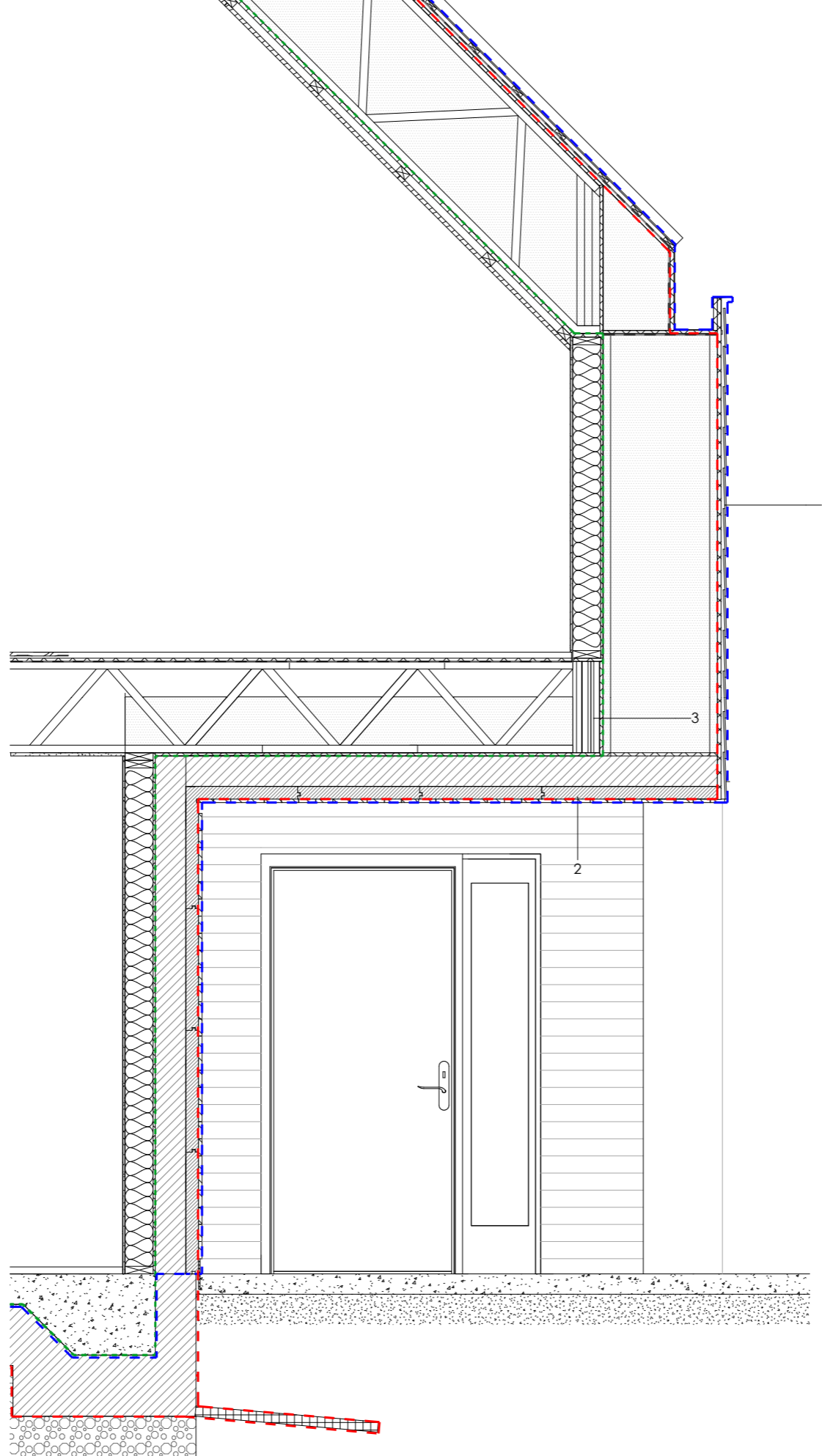
PASSIVE COOLING - LOUNGES
 Provides sun shading in summer months to maintain solar heat gain.





1.13 Vertical cross section

1. roof assembly:
 thermal bridge free to .006 btu/hrft²f0
 24 ga. standing seam metal roofing
 reverse board battens (1x3 over 2x4)
 5/8" zip sheathing taped and sealed
 waterproofing
 24" open web joists infill with knauff mineral wool
 1/2" osb taped and sealed
 2x2 wood blocking 16" o.c. for electrical chase
 1/2" maple/birch veneer plywood
2. south wall:
 frame out on south wall
 hardieplank
 1/2" celotex sheathing
 24" wood i-joist filled with knauff mineral wool
3. built in gutter slope 1/4" per ft
4. 12" type ix eps foam insulation density=1.80 pcf,
 Rvalue = 5.00 per 1"
5. 4" pea rock
6. taped and sealed around block at top of wall
7. wall assembly:
 thermal bridge free to .006 btu/hrft²f0
 9.25" hardie board horiz. siding
 2 1/2" insofast
 6" eps foam insulation
 7/16" zip sheathing taped and sealed
 2x6 w/ infill knauff mineral wool insulation
 1/2" gwb finish
8. slab assembly:
 thermal bridge free to .006 btu/hrft²f0
 engineered backfill
 12" eps foam insulation seams taped and sealed
 10" compacted fill
 taped polyethylene water and vapor barrier
 6" reinforced concrete
 maple floor over 3/4" ply
9. 14" wood open web joist see struct.
10. w flange beam
11. gwb continues past flange
12. 2x3 railing 5" o.c.
13. clerestory polycarbonate. note: same detail turns
 corner and terminates at ceiling line
14. ridge vent
15. ridge beam. note: tape and seal osb air barrier to
 glulam beam.
16. 3' 2" thick eps frost skirt
17. osb sheathing continues on top of plate to inside
 to tape and seal to ceiling osb to maintain
 continuous air barrier.



1.18 Vertical section South wall

1. 9.25" hardieplank installed over insofast
2. floor/ roof assembly (R-75):
cedar Soffit- 1x4 T&G
inSoFast Insulation- 2 1/2" (R-10.5)
6" EPS Insulation- (R-4.17/in. = R-33.36)
zip roof sheathing system- 5/8" (vapor/air permeable)
18" Wood Web Joist Truss- 16" O.C.
11" Blown-In Insulation- Glass Mineral Wool (R-2.8/in. = R-31)
1/2" OSB Sheathing- Taped & Sealed (Vapor/Air Barrier)
Floor Finish per Room Finish Schedule
3. 3ply 18" LVL

- **challenges moving forward**

- 1 **Capitalize on the initial burst of activity and keep the momentum.**

- **challenges moving forward**

2 Continued financial and political support from the state is necessary...the expectation that the construction industry will move towards higher standards without incentive or regulation is naïve.

- **challenges moving forward**

3 **The lack of serious building or energy code implementation is a barrier...the 'regulatory' smell of codes is a cultural and political obstacle that hinders the advancement of building science.**

It is the architect's responsibility to raise expectations, from both the state and the construction industry.

- **challenges moving forward**

4 The continued support of subsidized housing must be maintained if not increased.

The investment by the state over the past four years into Passive House is a remarkable legacy, but one that still needs critical, positive investment.

It is our hope that the exponential growth of Passive House nationally will encourage South Dakota to stay the course.

Thank you!

