



Heritage Homes:

High Performance Living
in Harmony with Community



PENNSTATE



Presentation by
Kyle Macht and Chauntel Duriez

02 // OUR STORY // THE TEAM





02 // OUR STORY // THE CLIENT



“What is the point of buying your own home, if you cant afford to live in it?”
-Peg Hambrick Board Member of SCCLT

Private, nonprofit,
community-based
organization.

Formed in 1996 at the
request of State College
Borough.



Focus is on buying,
rehabilitating, and selling
houses.

Over 30 households



Acquires properties through
donation or purchase.

Separates ownership of the
land from the home.





02 // OUR STORY // THE CLIENT



“What is the point of buying your own home, if you cant afford to live in it?”
—*Peg Hambrick* Board Member of SCCLT

Design and build a moderately priced, owner-occupied duplex utilizing advanced and long-term cost-effective green technology.

Develop a sustainable project “using best practices to create lasting environmental, economic, community and organizational vitality.”

The Duplex:
2 Units, 3 Bedrooms, 1.5 baths with approximately 1250 square feet of living space in each unit.



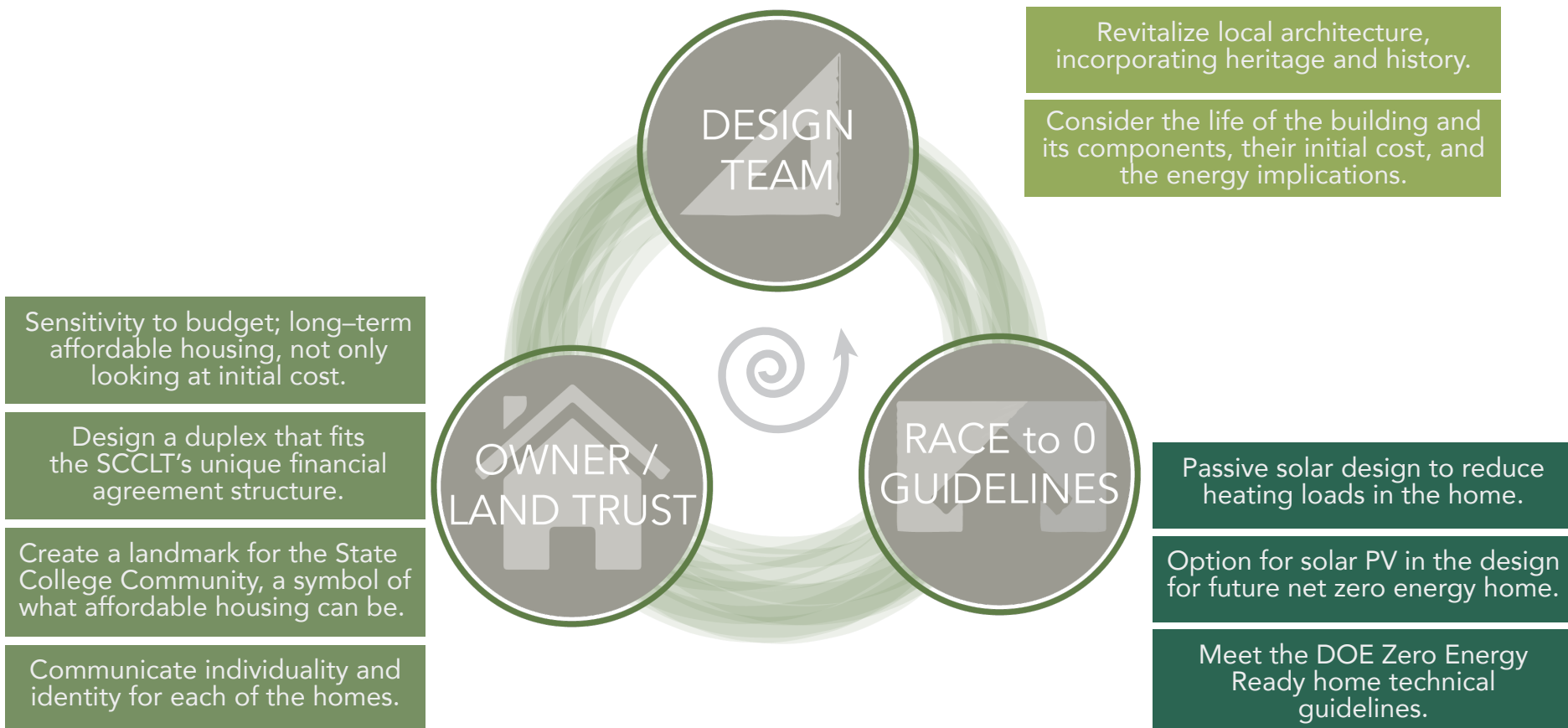
02 // OUR STORY // WHAT IS H4?

strong
design conscious
Heritage
client deliver brand
performance
create
effort combined goals solution
real high energy
community
place sense
Homes
share excited neighbors harmony



HERITAGE HOMES
H4: High Performance Living
in Harmony with Community

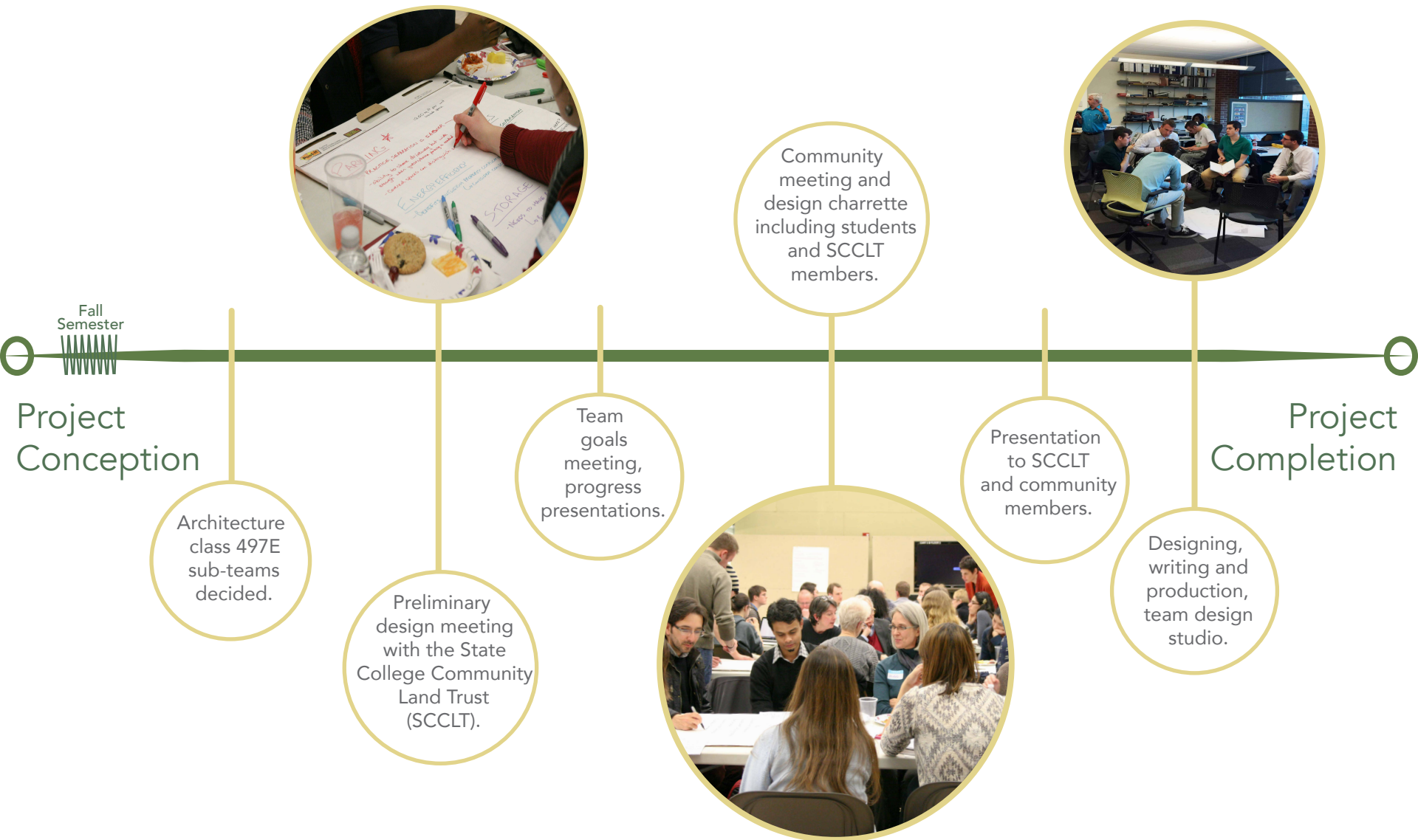
02 // OUR STORY // THE PROCESS



“ Engage Everybody Early on Everything^[1] ”



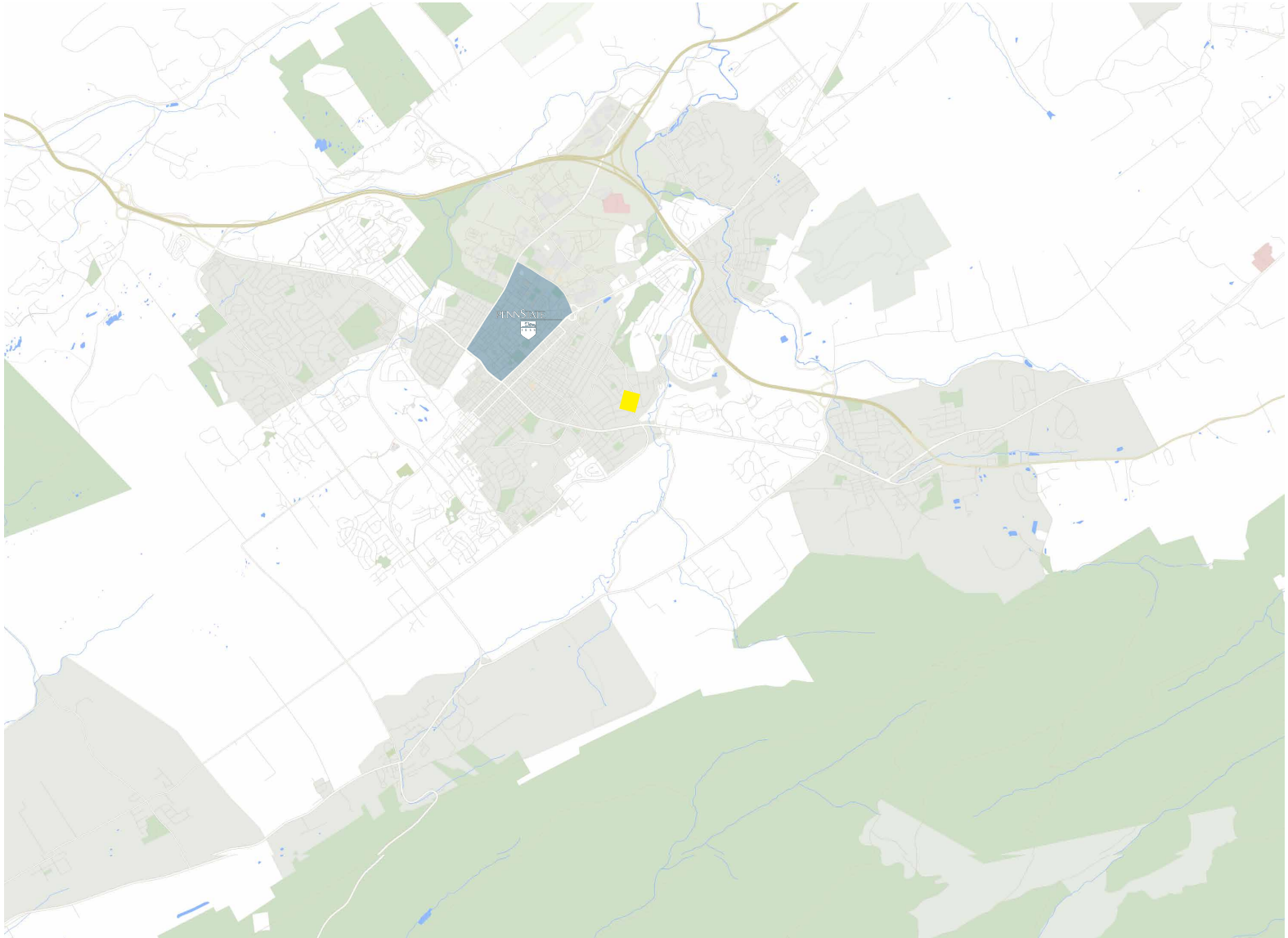
02 // OUR STORY // TIMELINE





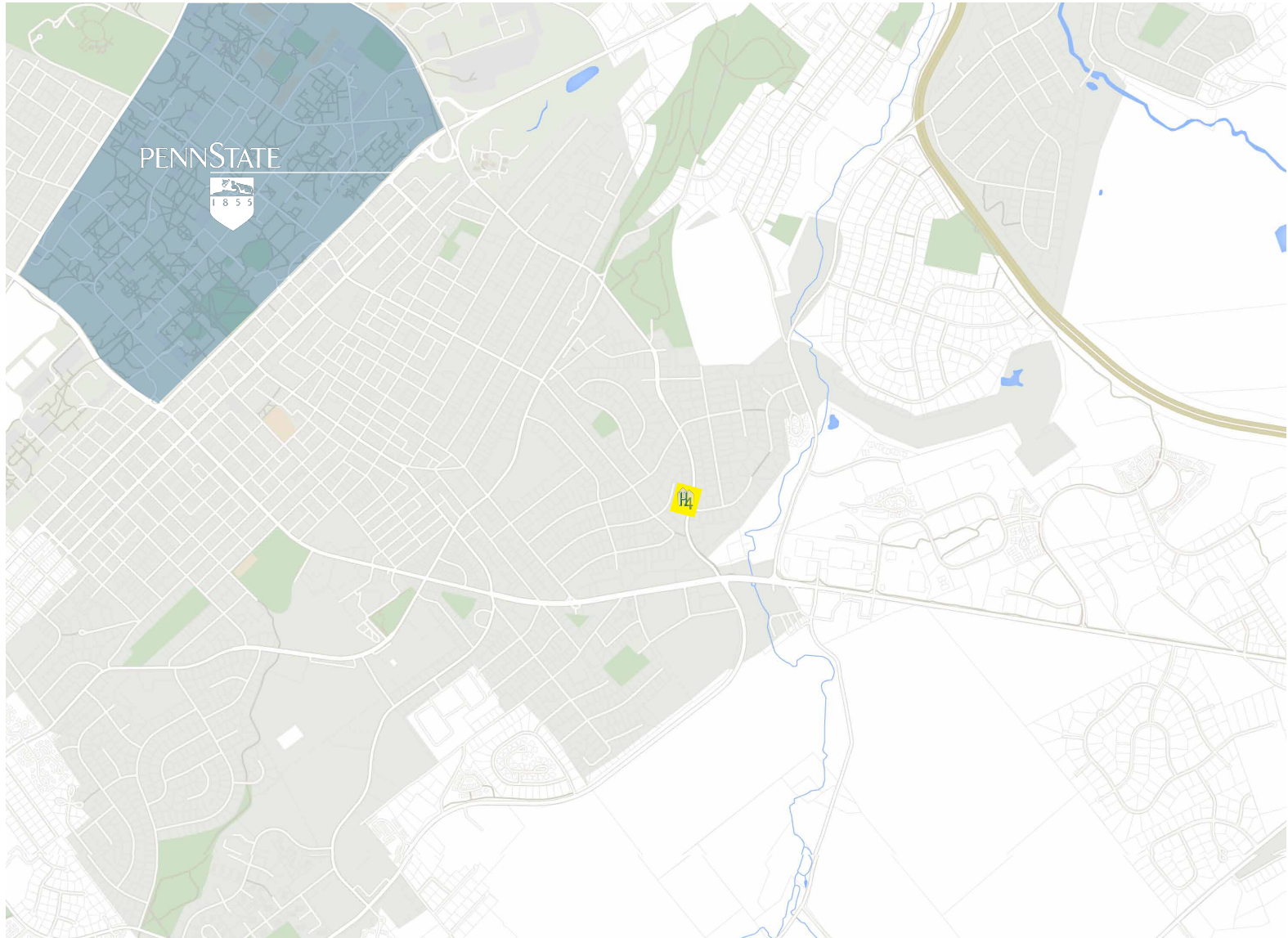
02 // SITE LOCATION

State College, Pennsylvania



02 // SITE LOCATION

State College, Pennsylvania



03 // SITE SPECIFICS

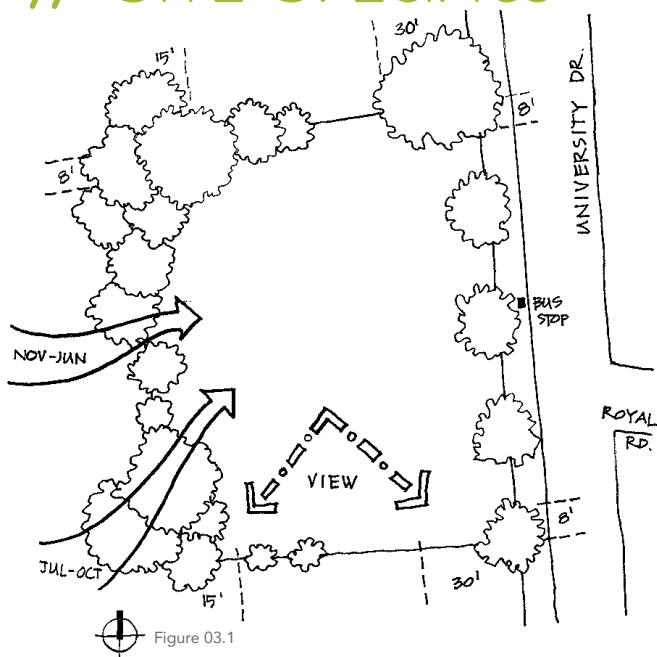
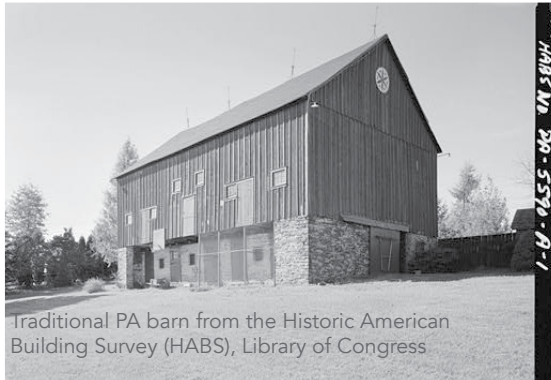


Figure 03.2 - View as seen from diagram 03.1

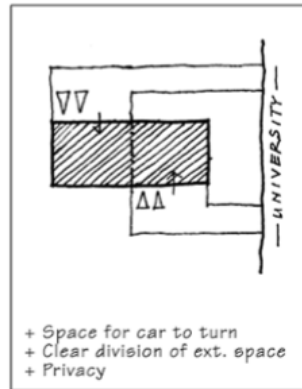


03 // HERITAGE PRECEDENTS

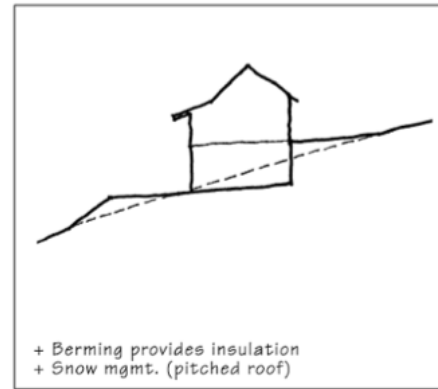
The "Bank Barn"



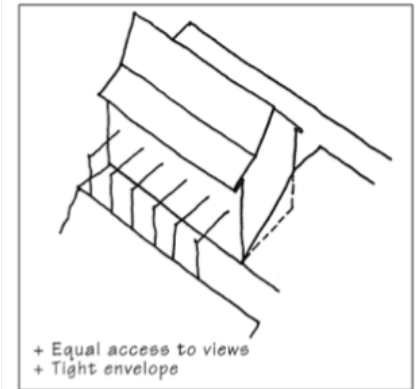
Traditional PA barn from the Historic American Building Survey (HABS), Library of Congress



- + Space for car to turn
- + Clear division of ext. space
- + Privacy



- + Berming provides insulation
- + Snow mgmt. (pitched roof)

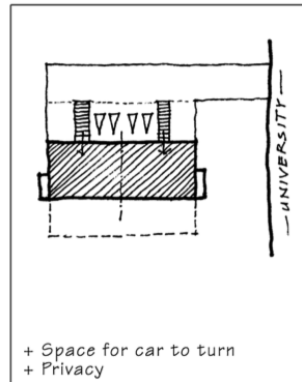


- + Equal access to views
- + Tight envelope

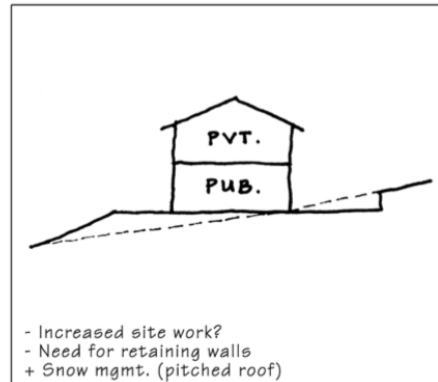
The "Pennsylvania Farmhouse"



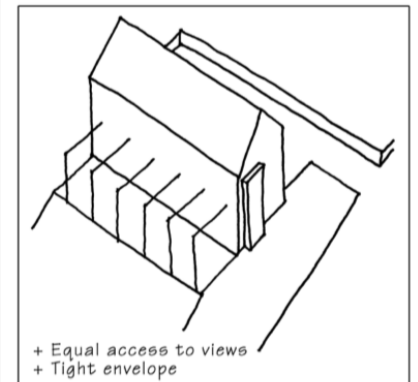
<http://img2-1.timeinc.net/toh/g/13/reader-remodel/05-whole-house/>



- + Space for car to turn
- + Privacy



- Increased site work?
- Need for retaining walls
- + Snow mgmt. (pitched roof)



- + Equal access to views
- + Tight envelope

03 // VISUAL PREFERENCE SURVEY

Most Preferred Choices



Building form // Bank Barn

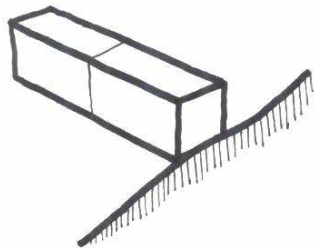


Interiors // Rustic Modern



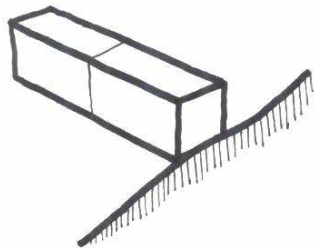
Exterior // Board and Batten

03 // DESIGN DECISIONS

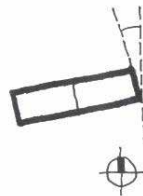
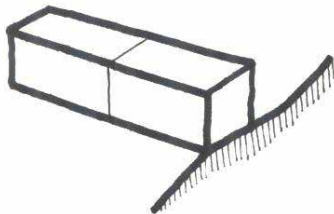


North-South orientation for solar gain

03 // DESIGN DECISIONS

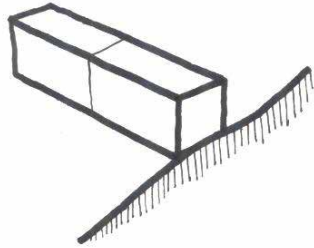


North-South orientation for solar gain

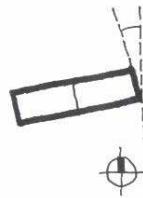
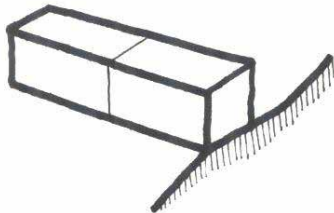


10 degree shift in N-S orientation to maximize street presence

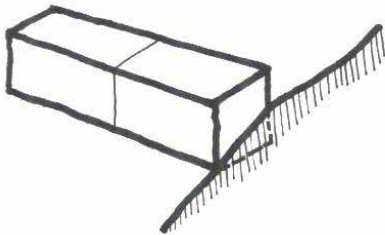
03 // DESIGN DECISIONS



North-South orientation for solar gain

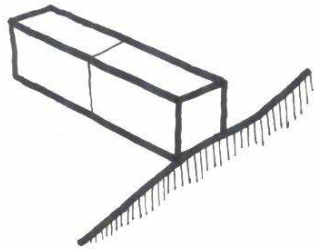


10 degree shift in N-S orientation to maximize street presence

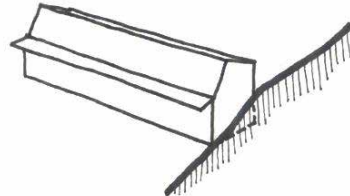


Building bermed as a response to site topography

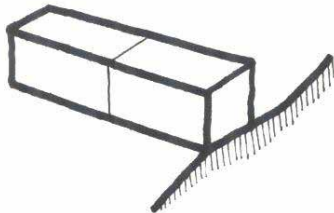
03 // DESIGN DECISIONS



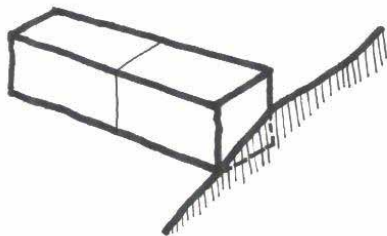
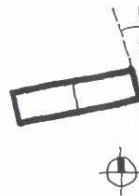
North-South orientation for solar gain



'Bank barn' roof form respects historic regional context



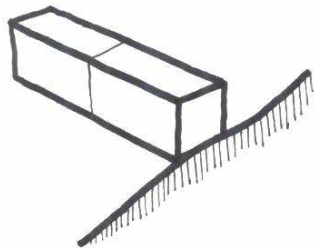
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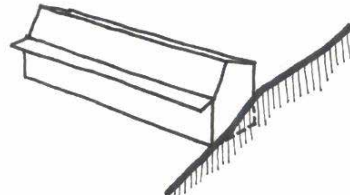
Building bermed as a response to site topography



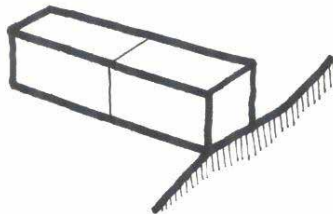
03 // DESIGN DECISIONS



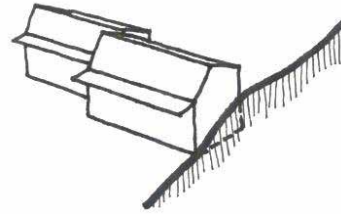
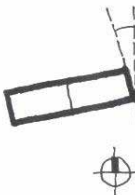
North-South orientation for solar gain



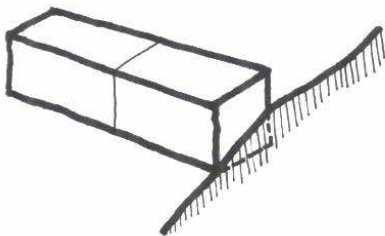
'Bank barn' roof form respects historic regional context



10 degree shift in N-S orientation to maximize street presence



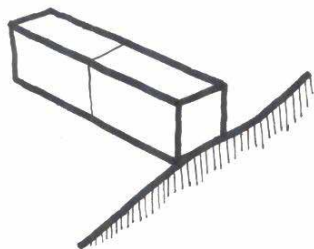
Units staggered for individuality



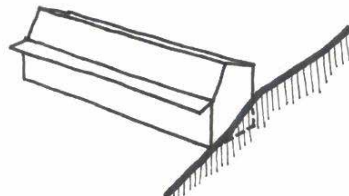
Building bermed as a response to site topography



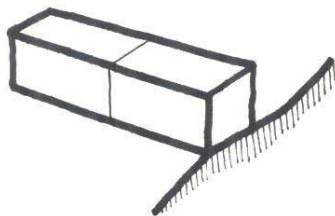
03 // DESIGN DECISIONS



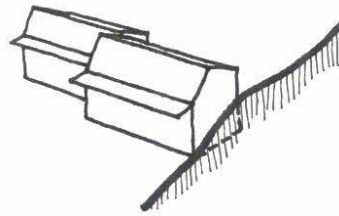
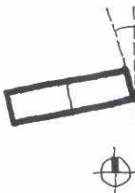
North-South orientation for solar gain



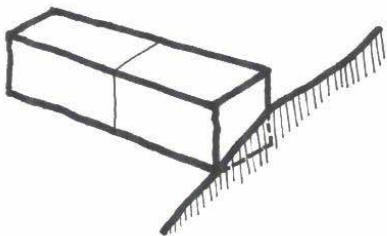
'Bank barn' roof form respects historic regional context



10 degree shift in N-S orientation to maximize street presence



Units staggered for individuality



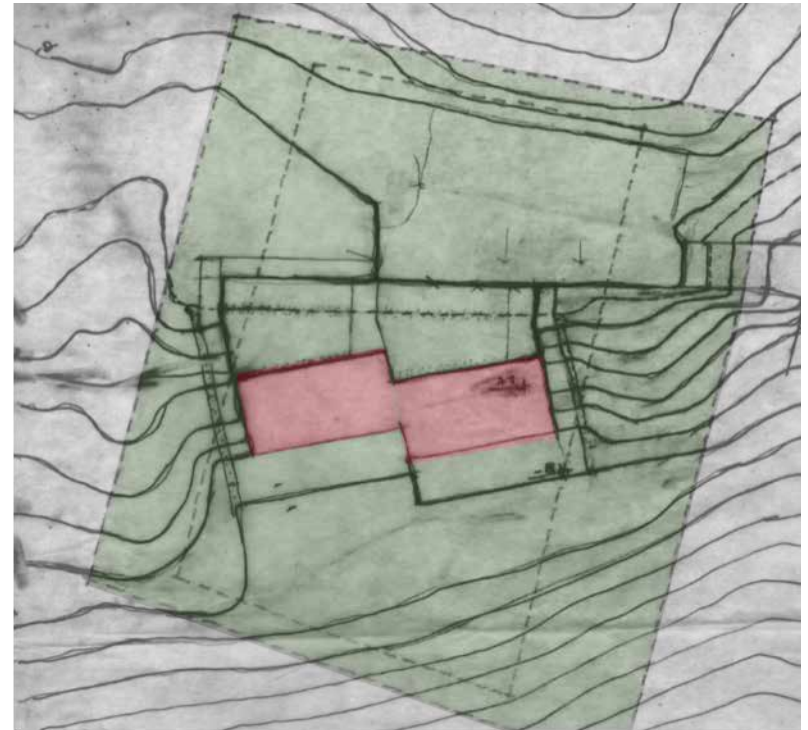
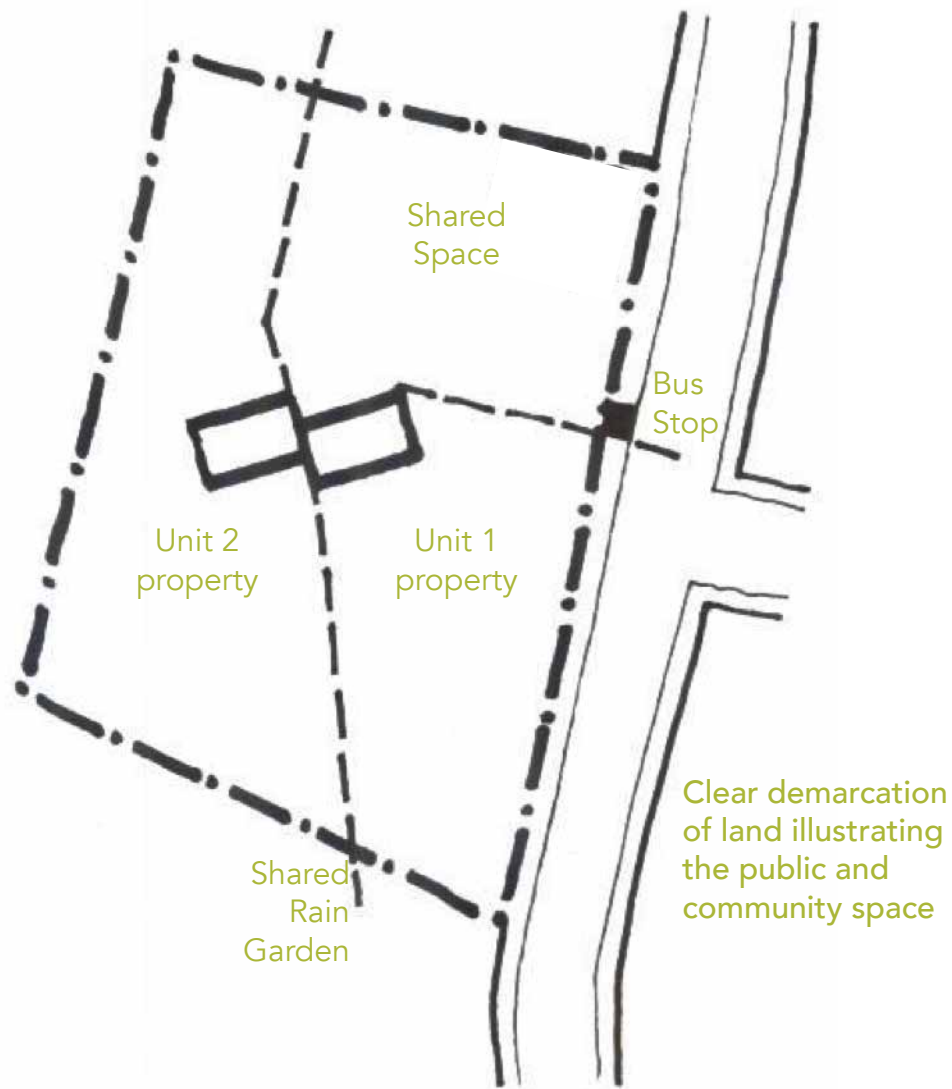
Building bermed as a response to site topography



Unique batten arrangement for each unit



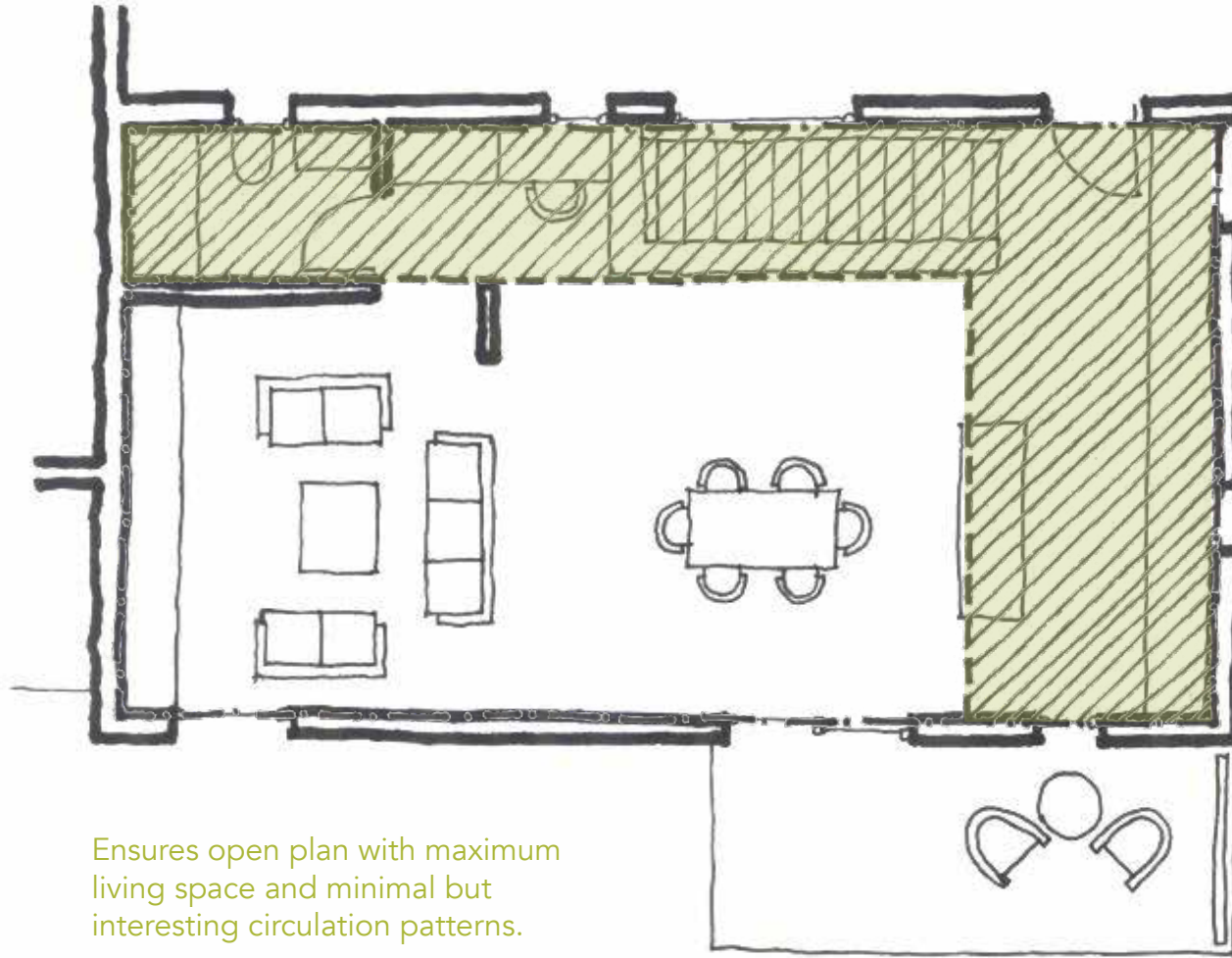
03 // DESIGN GOALS



Topography work

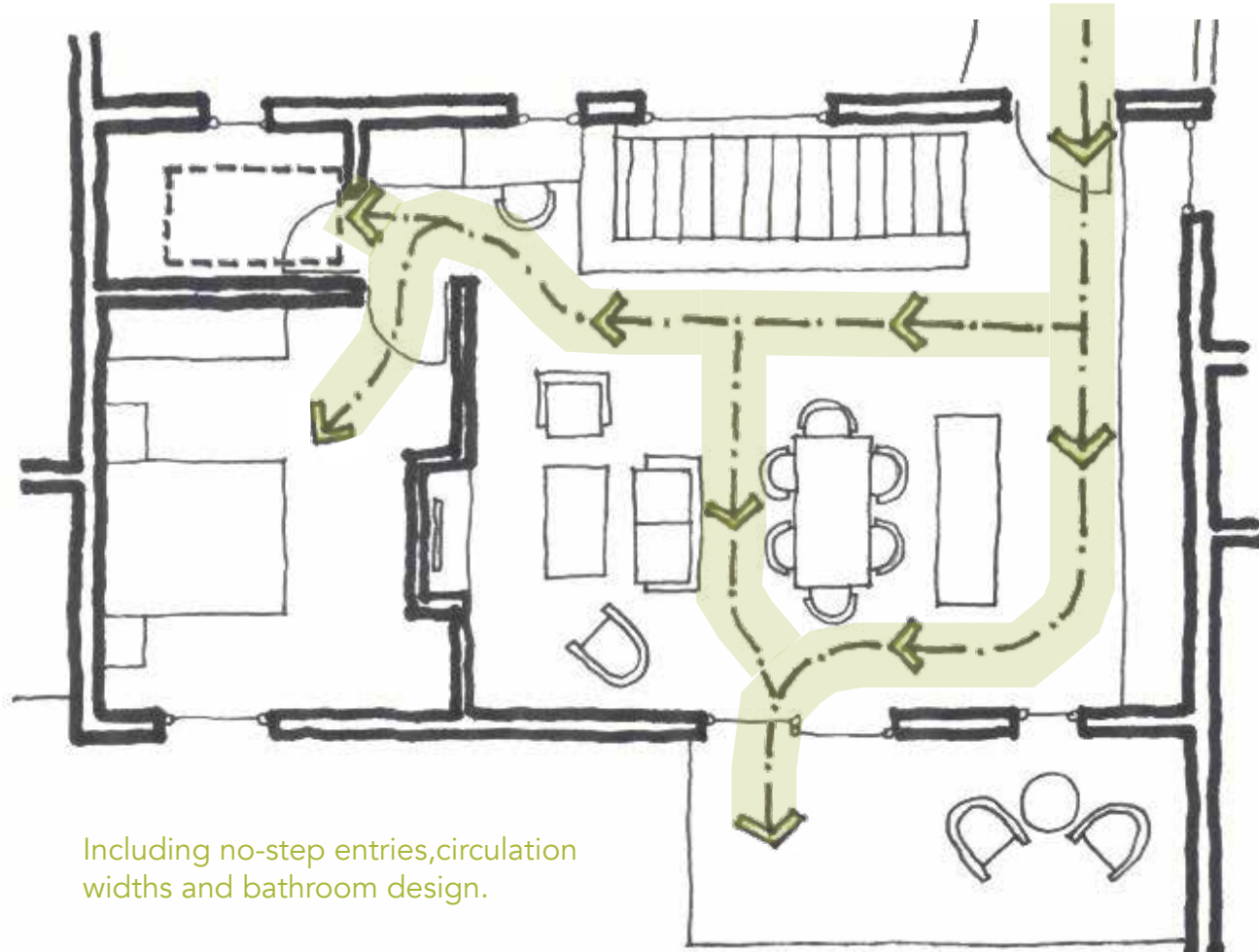
Taking advantage of sloping site, berming allows walkout possibilities for bedroom floors.

03 // SERVICE AND LIVING ZONES



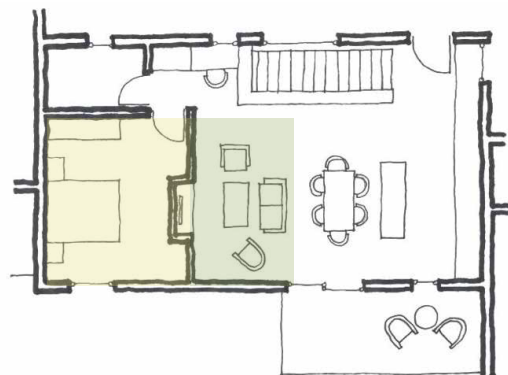
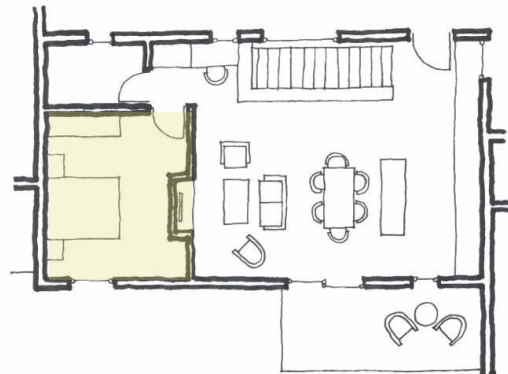
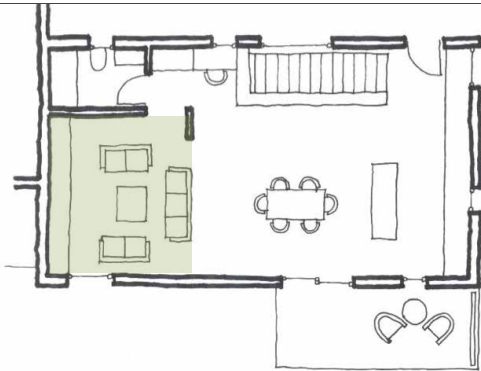
Ensures open plan with maximum living space and minimal but interesting circulation patterns.

03 // VISITABILITY



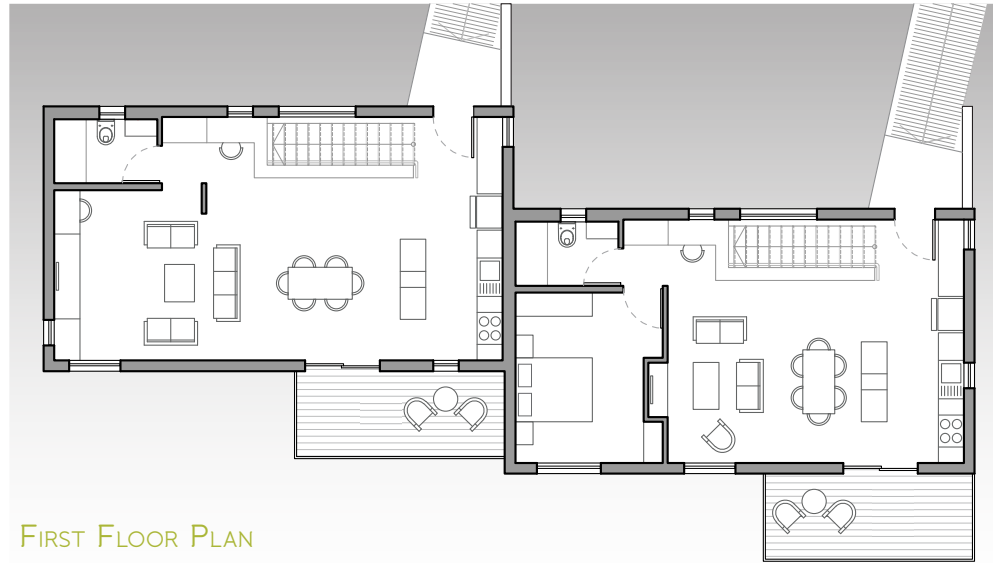
Including no-step entries, circulation widths and bathroom design.

03 // DESIGNED FLEXIBILITY

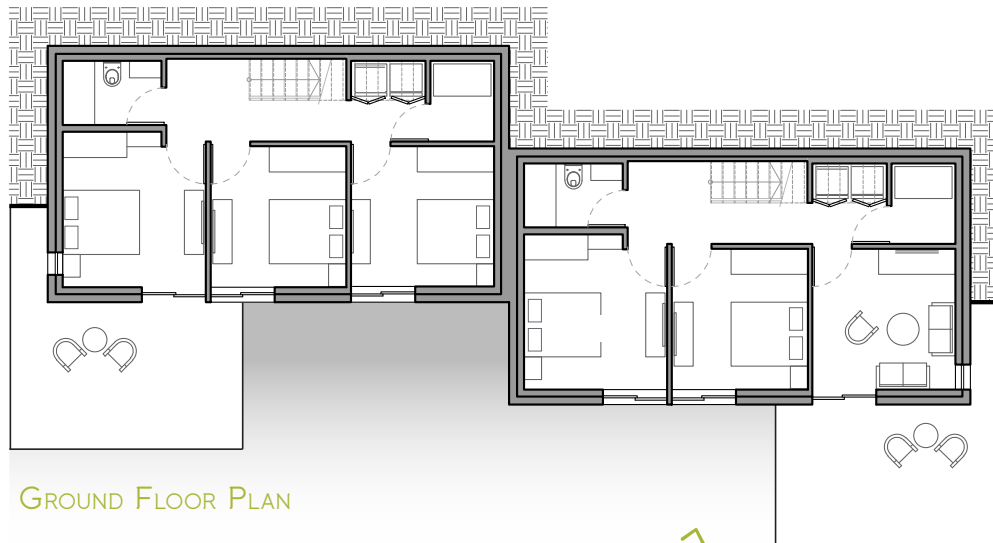


Space Flexibility for changing needs:

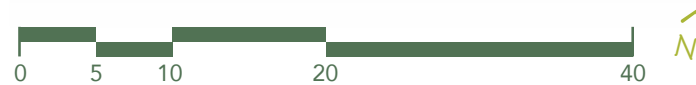
space on both the first floor, and the ground floor can be converted from living space to an additional bedroom or vice-versa. This flexibility allows for satisfaction of any growing family's needs from small children to aging in place.



FIRST FLOOR PLAN

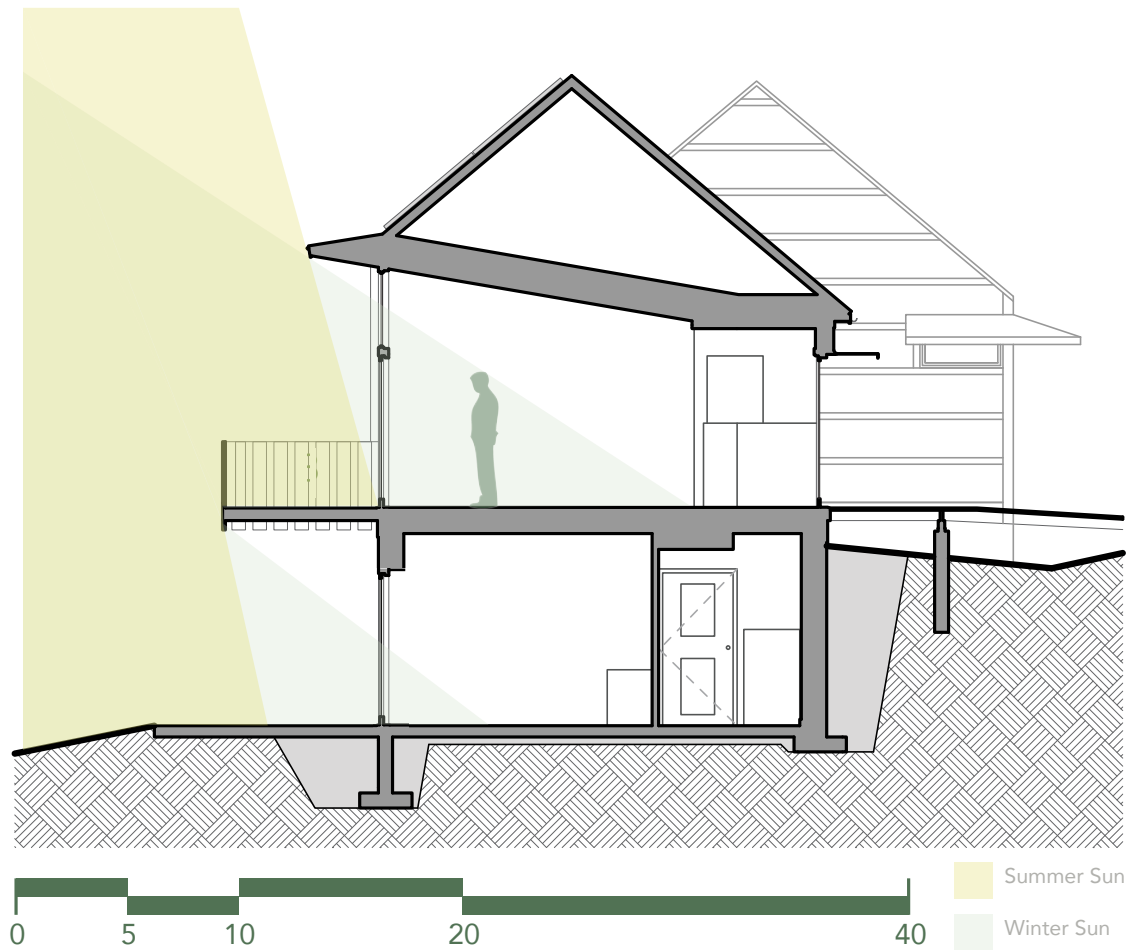


GROUND FLOOR PLAN



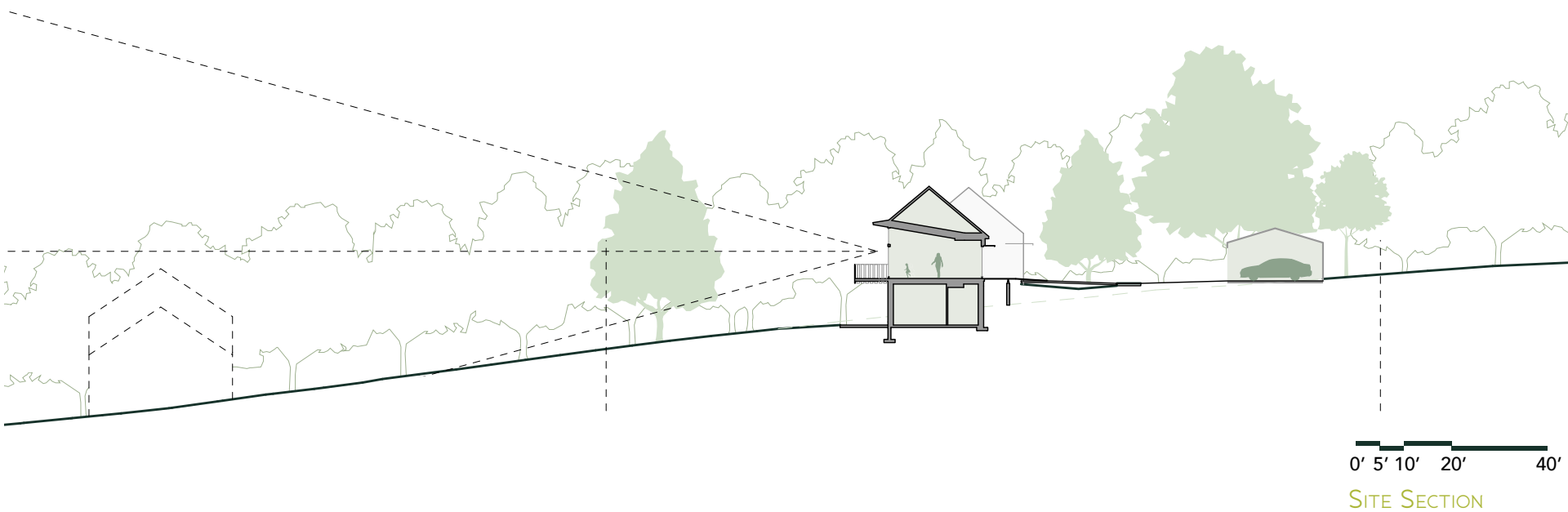


03 // TRANSVERSE SECTION



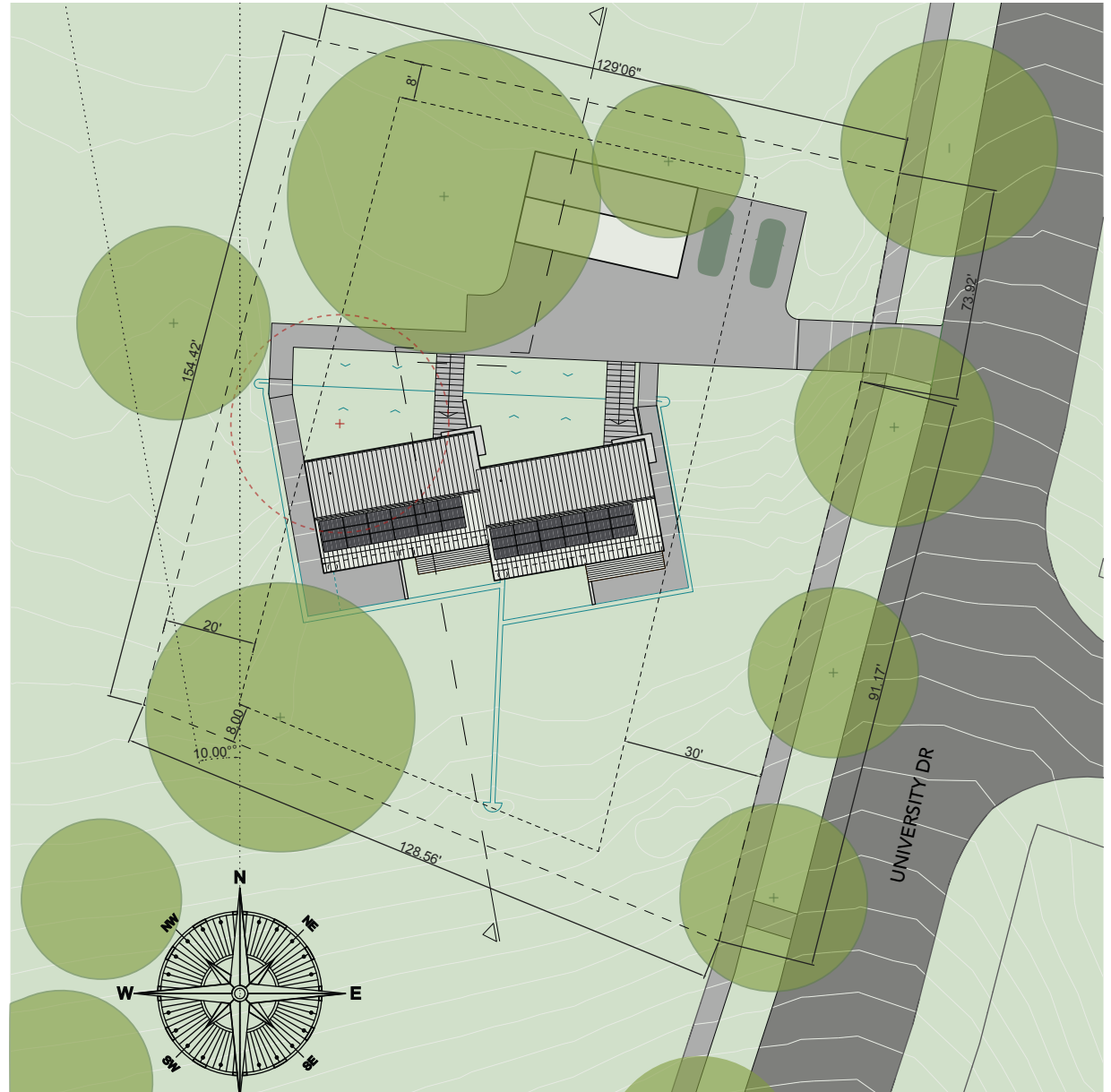


03 // SITE SECTION





03 // SITE PLAN



03 // DUPLEX ENTRY



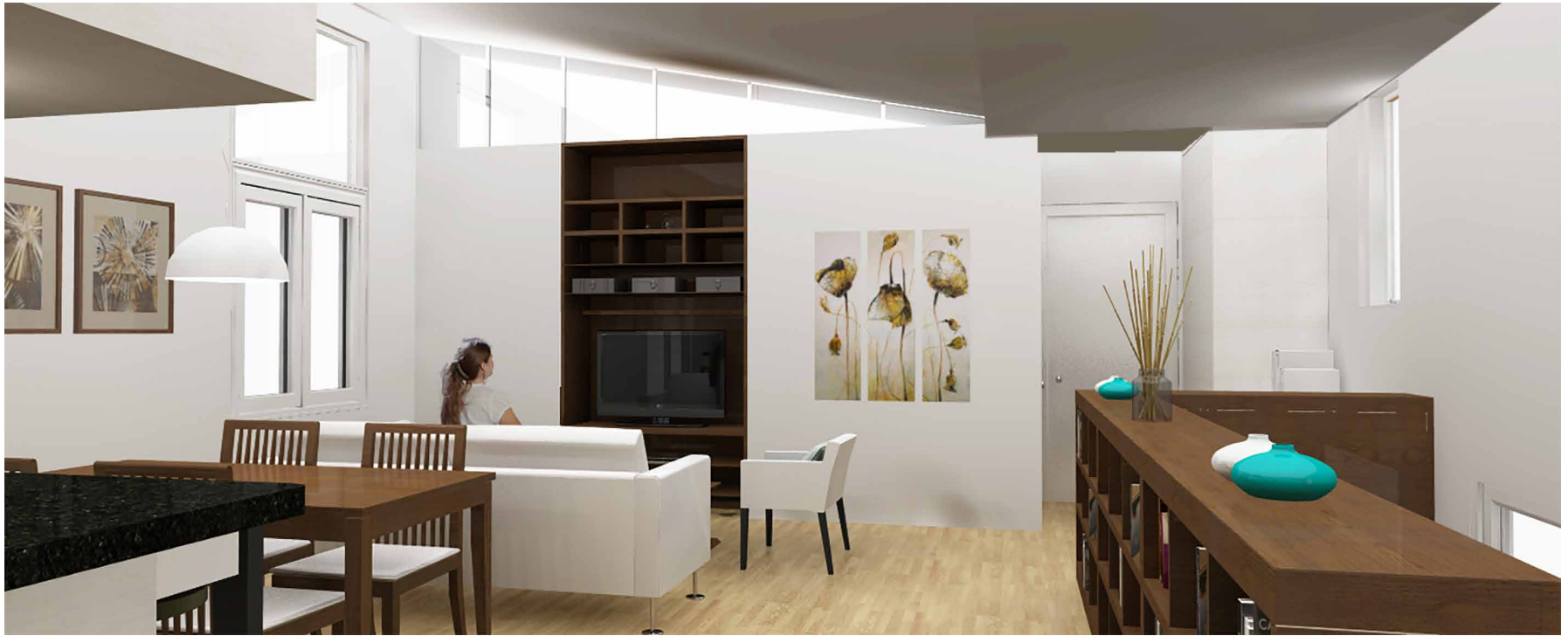
View of duplex from main site entry

03 // SOUTH YARD

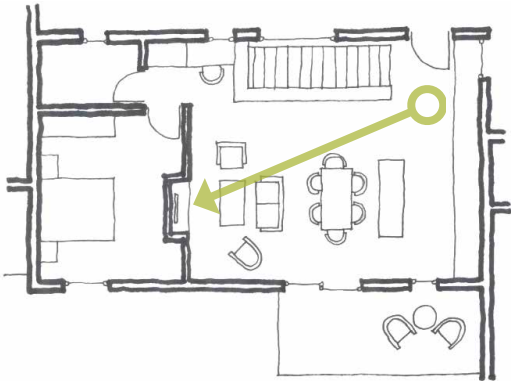


View of duplex from main yard, looking north

03 // INTERIOR ENTRY VIEW



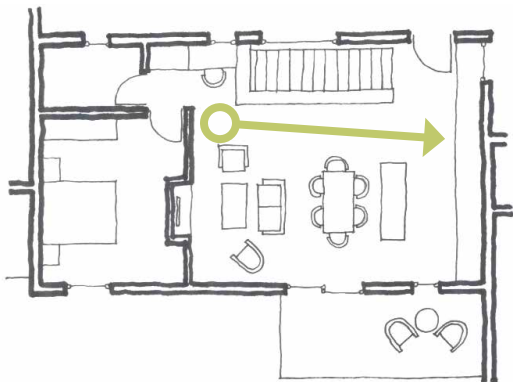
View of living area from entry



03 // LIVING AREA VIEW



View of living area from entry

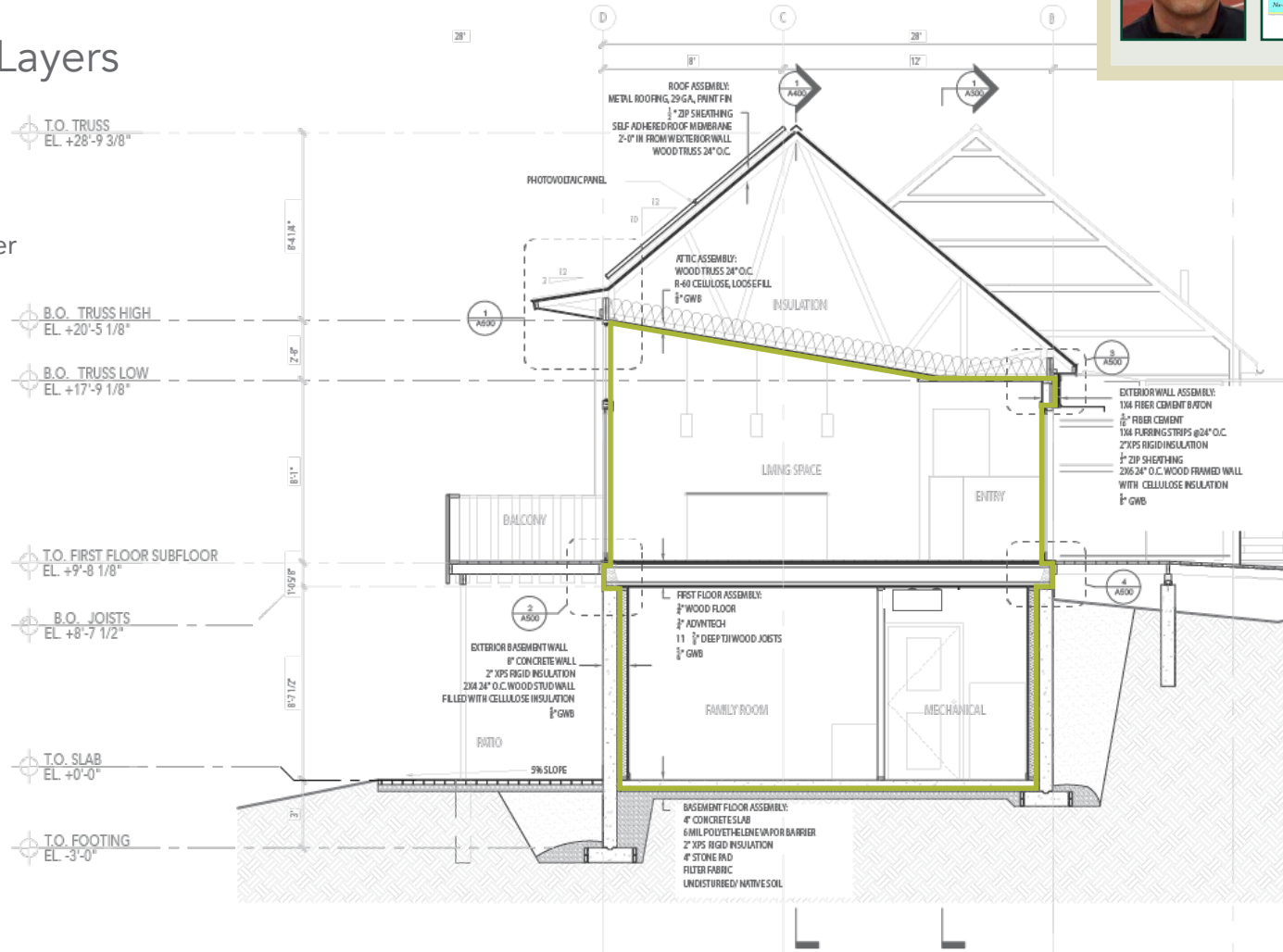


04 // ENVELOPE DURABILITY

The 4 Control Layers

- Rain control layer
- Air control layer
- Vapor control layer
- Thermal control layer

Unity of the
Envelope:
Foundation, Walls,
Fenestrations, and
Roof.



PETER VARGO

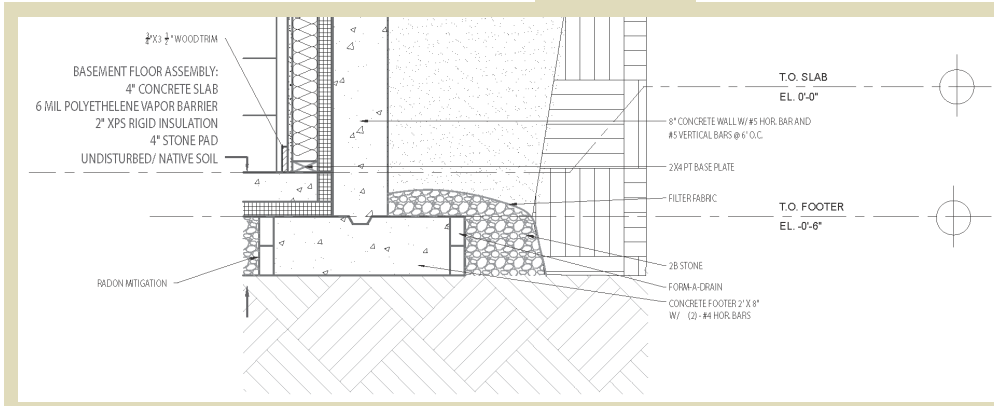
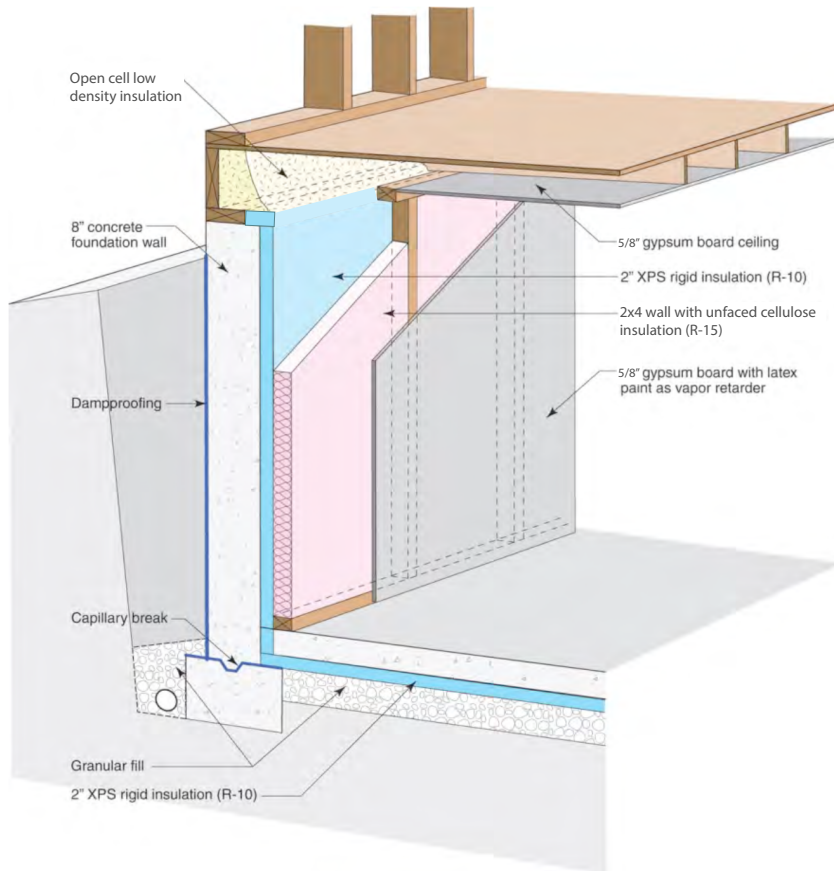




04.1 // FOUNDATION



CHAD OWENS



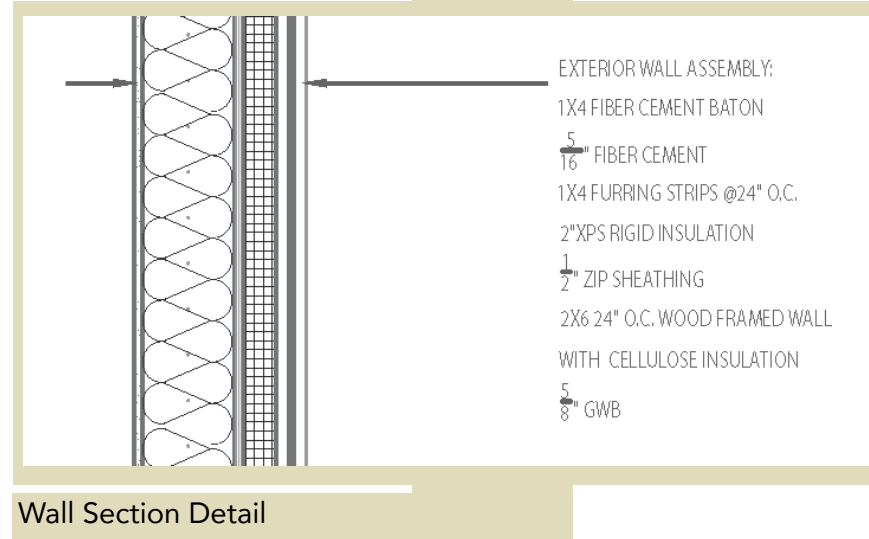
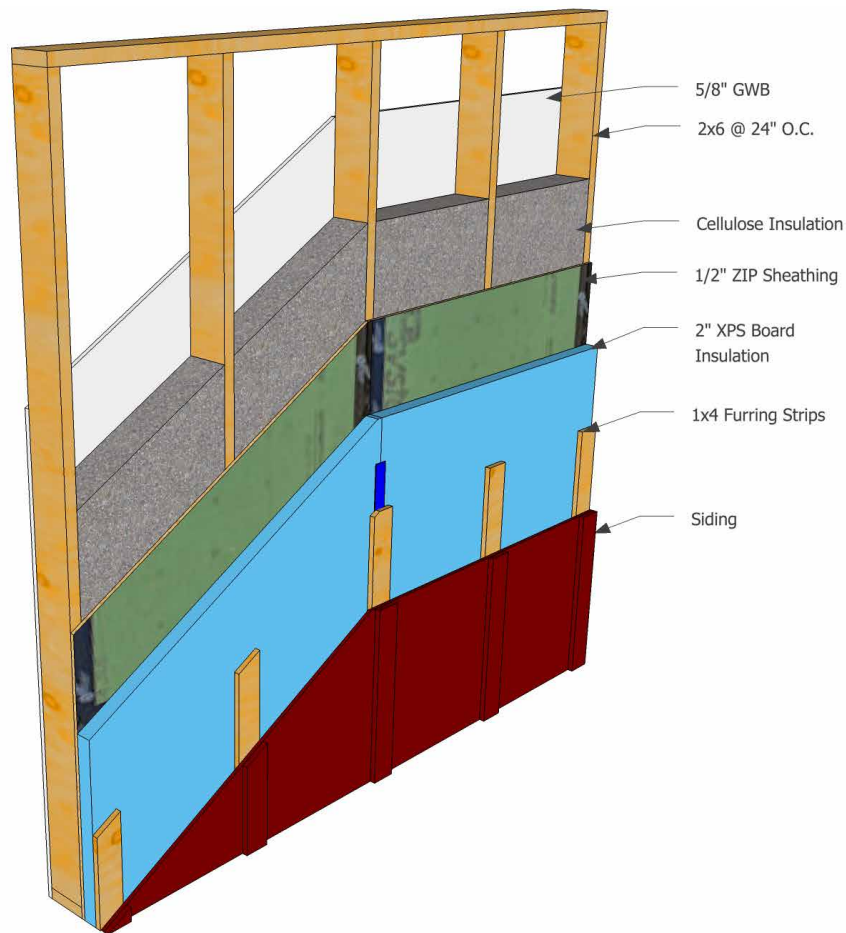
Foundation Section Detail

04.3.5 Summary of the comparison of two below-grade wall systems

	Cast-In-Place (CIP)	Superior Wall
Energy Performance	● ● ● ● ●	● ● ● ● ●
Economy	● ● ● ● ●	● ● ● ● ●
Local Availability	● ● ● ● ●	● ● ● ● ●
Ease of Construction	● ● ● ● ●	● ● ● ● ●



04.2 // WALLS



04.3.4 Comparison of three different wall assemblies based on various criteria

	Staggered 2x8 wood frame	SIP (ThermaSteel)	Advanced 2x6 wood frame
Energy Performance	●●●●●	●●●●●	●●●●●
Cost	●●●●●	●●●●●	●●●●●
Durability	●●●●●	●●●●●	●●●●●
Local Availability	●●●●●	●●●●●	●●●●●
Ease of Construction	●●●●●	●●●●●	●●●●●

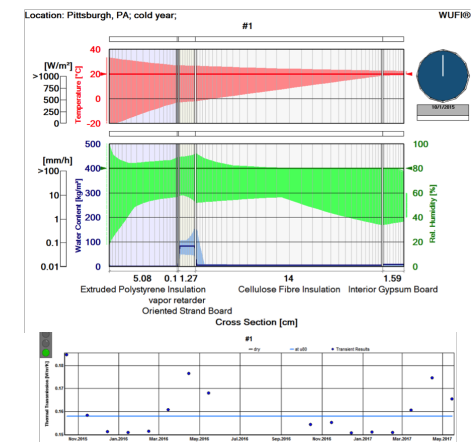


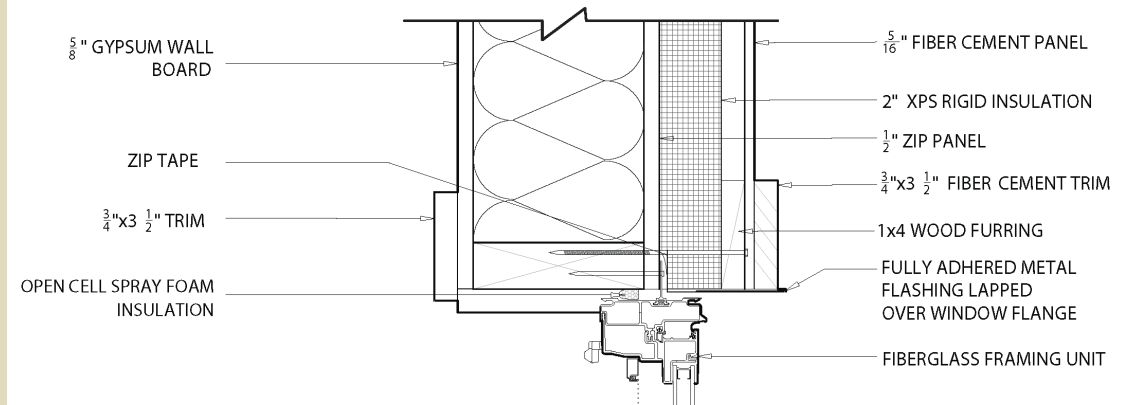
Figure 04.1.2 - WUFI analysis



04.3 // FENESTRATION



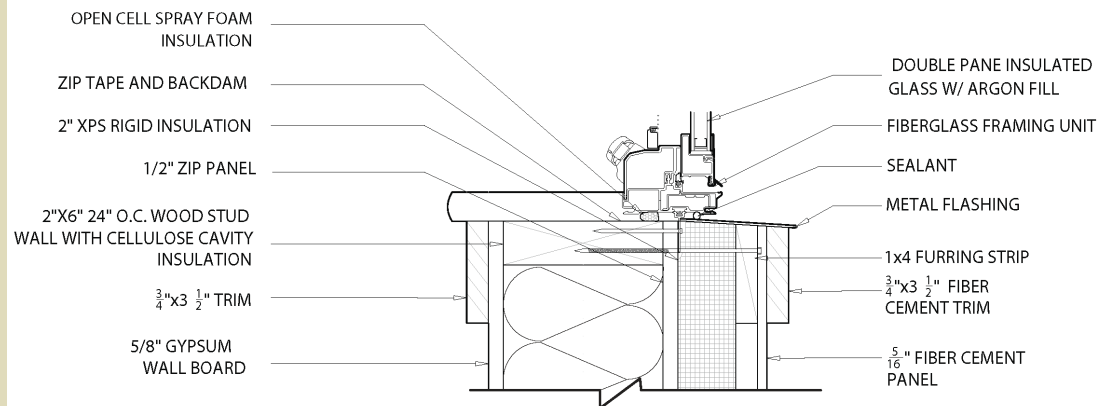
CHAD OWENS



Window Detail 04.3.1

04.3.6 Comparison of three different window frame material

	Wood	Fiberglass	Vinyl
Energy Performance	●●●●●	●●●●●	●●●●●
Cost	●●●●●	●●●●●	●●●●●
Durability	●●●●●	●●●●●	●●●●●
Local Availability	●●●●●	●●●●●	●●●●●
Strength	●●●●●	●●●●●	●●●●●



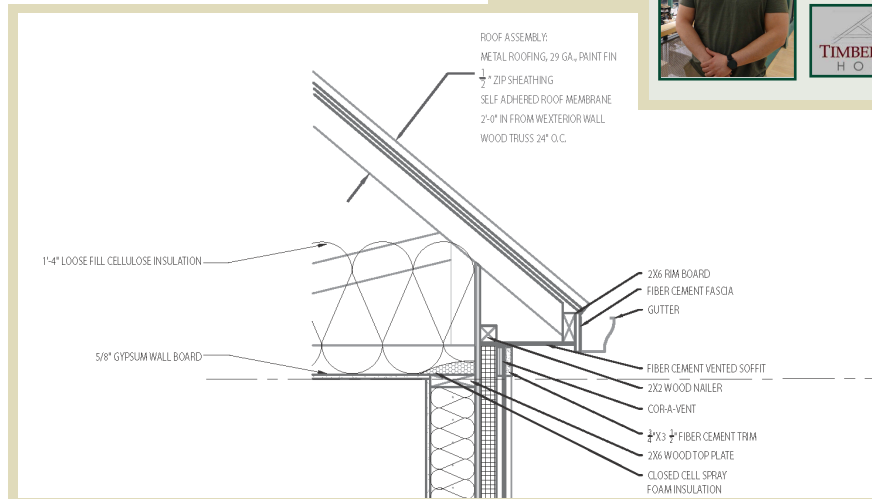
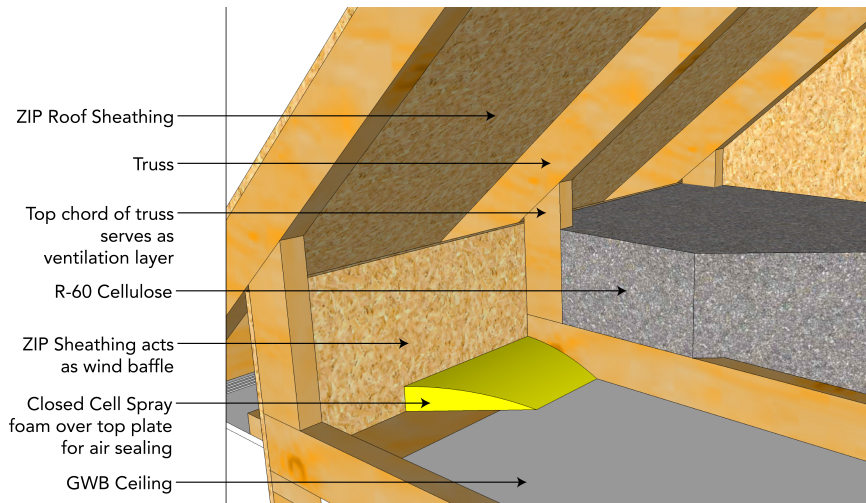
Window Detail 04.3.2



04.4 // ROOF - ATTIC



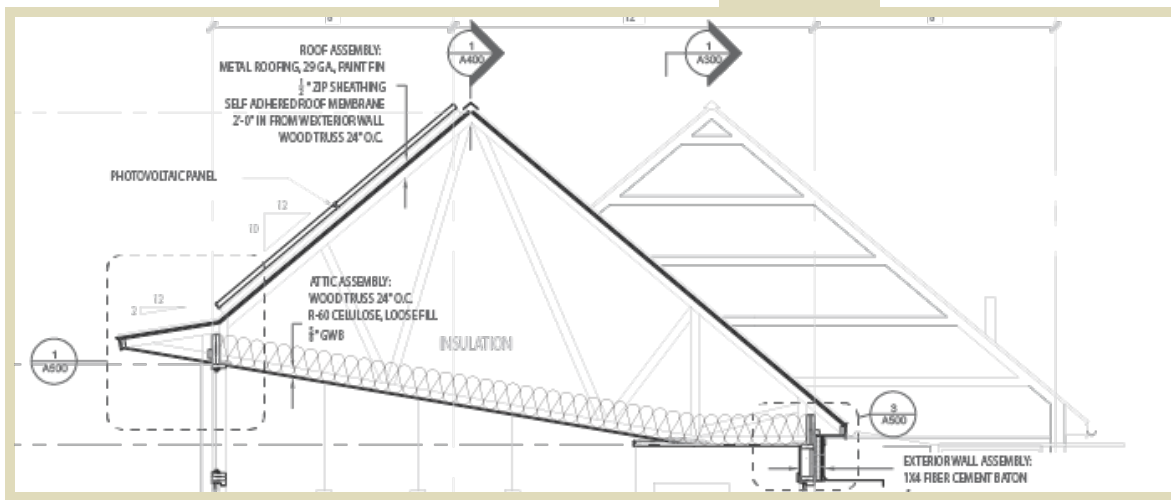
CHAD OWENS



Roof Section Detail 04.4.1

4.3.2 - Comparison of different roof assemblies based on various criteria

	Vented with Attics	Vented without Attics (Cathedral Ceilings)	Unvented with Attics (Cathedral Ceilings)	Unvented without Attics (Cathedral Ceilings)
	Roof 1B - 30in Blown Cellulose Insulation	Roof 3A - 11.5in Dense Pack Cellulose + 1in XPS Cellulose in Dimensional Lumber + 4in XPS Exterior Insulation inside Engineered Joist	Roof 6A - 9.25in Dense Pack Cellulose in Dimensional Lumber + 4in XPS Exterior Insulation	Roof 7A - 12in EPS Structurally Insulated Panel
Energy Performance (R-value)	●●●●●	●●●●●	●●●●●	●●●●●
Cost	●●●●●	●●●●●	●●●●●	●●●●●
Durability	●●●●●	●●●●●	●●●●●	●●●●●
Material Embodied energy	●●●●●	●●●●●	●●●●●	●●●●●
Local Availability	●●●●●	●●●●●	●●●●●	●●●●●
Ease of Construction	●●●●●	●●●●●	●●●●●	●●●●●



Roof Section Detail 04.4.2

Complete Wall Section

Complete Wall Section

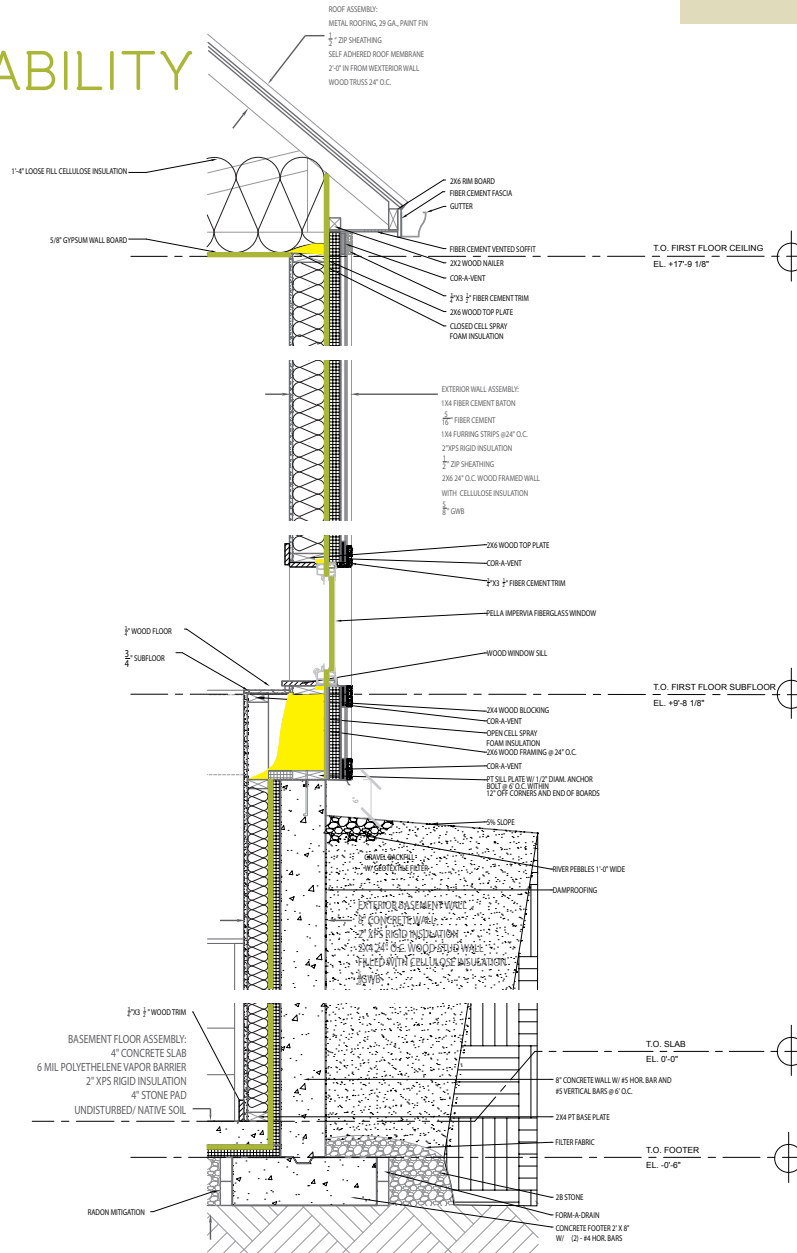
04 // ENVELOPE DURABILITY

The 4 Control Layers

- Rain control layer
- Air control layer
- Vapor control layer
- Thermal control layer

Unity of the Envelope:

Foundation, Walls,
Fenestrations, and
Roof.



Complete Wall Section



04 // CHECKLISTS



ENERGY STAR Certified Homes, Version 3 (Rev. 07) Water Management System Builder Checklist^{1,2}

Home Address: _____

1. Water-Managed Siding

- 1.1 Patio slabs, porch slab surface or 10 ft., which
- 1.2 Back-fill has been tam
- Footnote for alternative
- 1.3 Capillary break beneath either: ≥ 6 mil polyethy
- 1.4.1 Placed beneath s
- 1.4.2 Lapped up each
- 1.4.3 Secured in the gr
- 1.5 Exterior surface of belc
- a) For poured concre
- b) For wood framed w
- 1.6 Class 1 vapor retarder
- 1.7 Sump pump covers me
- 1.8 Drain tile installed at th
- 1.9 Drain tile below the
- of ½ to 1 in. washed o
- or sloped to discharge

2. Water-Managed Wall

- 2.1 Flashing at bottom of e
- 2.2 Fully sealed continuo
- 2.3 Window and door op
- 2.4 Water-Managed Roof
- 3.1 Step and kick-out flash
- 3.2 For homes that don't h
- 3.3 Self-sealing bitumin
- 3.4 In 2009 IECC Climate
- 4.1 Wall-to-wall carpet not
- 4.2 Cement board or equiv
- 4.3 In Warm-Humid climat
- 4.4 Building materials with
- 4.5 Framing members & i

4. Water-Managed Build

- 4.1 Wall-to-wall carpet not
- 4.2 Cement board or equiv
- 4.3 In Warm-Humid climat
- 4.4 Building materials with
- 4.5 Framing members & i

Notes:

1. At the discretion of the
2. For Prescriptive Path: A
- Builder Employee: _____
- Builder Signature: _____
- Builder has completed Bul
- Rater Signature: _____

Notes:

1. The specifications in
2. Effective for homes permitte



ENERGY STAR Certified Homes, Version 3 (Rev. 07) Thermal Enclosure System Rater Checklist

5. Air Sealing

- 5.1 Penetrations to uncondit
- 5.1.1 Duct / flue shaft
- 5.1.2 Plumbing / piping
- 5.1.3 Electrical wiring
- 5.1.4 Bathroom and kit
- 5.1.5 Recessed lighting
- Also, if in insulate
- 5.1.6 Light tubes adjac
- 5.2 Cracks in the building en
- 5.2.1 All above-grade
- 5.2.2 At top of walls a
- 5.2.3 Drywall sealed to
- 5.2.4 Rough opening s
- 5.2.5 Masonry joints b
- 5.2.6 All seams betwe
- 5.2.7 In multifamily bui
- 5.3 Other openings
- 5.3.1 Doors adjacent to
- 5.3.2 Attic access pane
- 5.3.3 Whole-house fan

Rater Name: _____

Rater Name: _____

Builder Employee: _____

Notes:

1. At the discretion of the
2. For Prescriptive Path: A
- Builder Employee: _____
- Builder Signature: _____
- Builder has completed Bul
- Rater Signature: _____

Notes:

1. The specifications in
2. Effective for homes permitte



ENERGY STAR Certified Homes, Version 3 (Rev. 07) Thermal Enclosure System Rater Checklist

Home Address: _____

City: _____

State: _____

Zip Code: _____

Must Correct

Builder Verified

Rater Verified

N/A

1. High-Performance Fenestration

1.1 Prescriptive Path: Fenestration shall meet or exceed ENERGY STAR requirements¹1.2 Performance Path: Fenestration shall meet or exceed 2009 IECC requirements²

2. Quality-Installed Insulation

2.1 Ceiling, wall, floor, and slab insulation levels shall comply with one of the following options:

2.1.1 Meet or exceed 2009 IECC levels^{13,17} OR:2.1.2 Achieve ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, excluding fenestration and per guidance in Footnote 3d. AND home shall achieve ≤ 50% of the infiltration rate in Exhibit 1 of the National Program Requirements¹⁴

2.2 All ceiling, wall, floor, and slab insulation shall achieve RESNET-defined Grade 1 installation or, alternatively, Grade II for surfaces that contain a layer of continuous, air impermeable insulation ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8

3. Fully-Aligned Air Barriers¹⁵

At each insulated location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows:

• At interior or exterior surface of ceilings in Climate Zones 1-3; at interior surface of ceilings in Climate Zones 4-8. Also, include barrier at interior edge of attic eave in all climate zones using a wind baffle that extends to the full height of the insulation. Include a baffle in every bay or a tabbed baffle in each bay with a soffit vent that will also prevent wind washing of insulation in adjacent bays

• At exterior surface of walls in all climate zones; and also at interior surface of walls for Climate Zones 4-8¹⁶• At exterior surface of floors in all climate zones, including supports to ensure permanent contact and blocking at exposed edge^{16,9}

3.1 Walls¹⁶

3.1.1 Walls behind showers and tubs

3.1.2 Walls behind fireplaces

3.1.3 Attic knee walls¹¹

3.1.4 Skylight shaft walls

3.1.5 Wall adjoining porch roof

3.1.6 Staircase walls

3.1.7 Double walls

3.1.8 Garage rim / band joint adjoining conditioned space

3.1.9 All other exterior walls

3.2 Floors

3.2.1 Floor above garage

3.2.2 Cantilevered floor

3.2.3 Floor above unconditioned basement or unconditioned crawlspace

3.3 Ceilings¹⁶

3.3.1 Dropped ceiling / soffit below unconditioned attic

3.3.2 All other ceilings

4. Reduced Thermal Bridging

4.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade 1 insulation extends to the inside face of the exterior wall below at these levels: CZ 1-5: ≥ R-5; CZ 6-8: ≥ R-30¹⁷4.2 For slabs on grade in CZ 4 and higher, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with thermal boundary of the walls^{4,5}

4.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8

4.4 Reduced thermal bridging at above-grade walls separating conditioned from unconditioned space (rim / band joints exempted) using one of the following options:¹⁷4.4.1 Continuous rigid insulation, insulated siding, or combination of the two: ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8^{14,15,16} OR:4.4.2 Structural Insulated Panels (SIPs)¹⁴ OR:4.4.3 Insulated Concrete Forms (ICFs)¹⁴ OR:4.4.4 Double-wall framing^{14,17} OR:

4.4.5 Advanced framing, including all of the items below:

4.4.5a All corners insulated ≥ R-6 to edge¹⁵ AND:4.4.5b All headers above windows & doors insulated ≥ R-3 for 2x4 framing or equivalent cavity width, and ≥ R-5 for all other assemblies (e.g., with 2x6 framing)¹⁵ AND:4.4.5c Framing limited at all windows & doors to one pair of king studs, plus one pair of jack studs per window opening to support the header and sill²⁰ AND:4.4.5d All interior / exterior wall intersections insulated to the same R-value as the rest of the exterior wall¹⁵ AND:4.4.5e Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in Climate Zones 5 through 8, 24 in. o.c. for 2x6 framing²¹

Effective for homes permitted starting 8/01/2013

Revised 6/01/2013

Page 3 of 16

Common Building Envelope Issues		Preventive Solutions	
Thermal Control		Thermal Control	
Thermal bridging		2" XPS continuous exterior insulating sheathing completely covers all the framing of the home. This satisfies Item 4.4.1 of Thermal Enclosure requirements in ENERGY STAR. (see construction drawings)	
Insulation	Air leakage	Common Building Envelope Issues	
	Wind	Construction and Architecture	
	Unenclosed	Ignoring passive solar design	These homes are optimized for passive solar design while taking advantage of a beautiful view of the mountains. This is all achieved while still providing a street presence for each unit. The southern ceiling of the home is lifted to enhance the view and allows solar radiation to penetrate deeper into the home. This is lifted in a way that does not compromise the simplicity, cost effectiveness, and performance of a vented attic. The southern windows were selected with a high SHGC at 0.5.
	Air leakage	Excess summer heat gain	The roof overhangs are properly sized to reduce the direct solar radiation in the harsh summer and a low SHGC on the western facade of the home reduced unwanted heat gain later in the day. The western trees also help in reducing unwanted western heat gain.
	Moisture	Complex "architectural features" such as bump outs, changes in wall planes, etc. can result in difficult details and can result in improper installation of air boundaries	Each side of the duplex is designed as a simple box without bumps, jogs, or overhangs to avoid these complex building enclosure details. This reduces cost and provides a tighter better performing product. The exterior finishes, which are outside of the control layers, varied in material to provide architectural interest without compromising the simplicity of the building envelope.
	Air sealing	Moisture Control	
	Forge behind	Roof run-off water hitting above-grade walls and foundation	Roof gutters and downspouts are to be installed on the north side, which are directed to rock garden swales providing proper drainage around the home. On the southern side rock gardens control the splash of water coming from the roof. This satisfies Item 3.2 of Water Management requirements in ENERGY STAR. (see construction drawings)
	Leaky	Water running to the house from roof rain water and improper drainage	Water is collected in gutters on the north side of the home and is directed around the home via rock garden swales which are located 10' away from the home to keep the drainage away from the foundation. Form-A-Drain allows for complete foundation drainage directing water away from the foundation. This satisfies Item 1.2 of Water Management requirements in ENERGY STAR. (see construction drawings for more details)
	Window could	Rain water penetrating behind the siding	Siding to be installed on 1x4 furring strips with SVS sturdy strips on the top and bottom of the ventilation layer provides an excellent rain screen allowing for proper drying and continuous drainage plane behind the siding. This satisfies Item 2.2 of Water Management requirements in ENERGY STAR. (see construction drawings for more details)
	Condense the inte	Capillary action from footing to foundation wall	A capillary break is to be installed between footing and foundation wall. Satisfy Item 1.3 and 1.4 of Water Management requirements in ENERGY STAR. (see construction drawings for more details)
	Air leakage	Ice dams and moisture accumulating on the underside of the roof deck causing decay and fungi growth	Proper attic ventilation, installing closed cell spray foam to air seal top plates and penetrations in the attic, and a raised heel truss providing full depth of insulation eliminates the possibility of ice dams. (see construction drawings for more details)
	N	Porous materials are installed in wet environment leads to mold growth	Materials shall be below the specified moisture content before they are enclosed. This satisfies Item 4.4 and 4.5 of Water Management requirements in ENERGY STAR.
	Vapor Control	Condensation inside the wall cavity	2" of XPS rigid sheathing external of the major control layers ensures condensation occurs on the exterior of these control layer. A hygrothermal analysis was performed to ensure that the exterior insulation is a high enough R-Value to keep the condensation plan exterior of the control layers.
		Water vapor from internal loads	Fujitsu mini splits have a dehumidification mode to better control the moisture within the building.

Table 04.5- Team's checklist for building enclosure durability



05 // INDOOR AIR QUALITY – AREAS OF CONCERN

Moisture Control

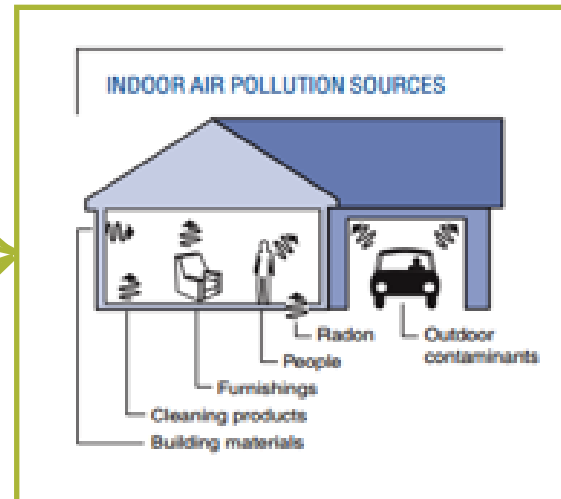
Pest Management

Noise Control

Building Material

Radon Control

Overall HVAC



MATT ROOKE



BRIAN AULT



05 // INDOOR AIR QUALITY – AREAS OF CONCERN

Moisture Control

Pest Management

- Wooden frame 6" from ground
- Termite Barrier
- Insect Screen

Noise Control

- Foams surrounding windows
- Low noise HVAC system

Building Material

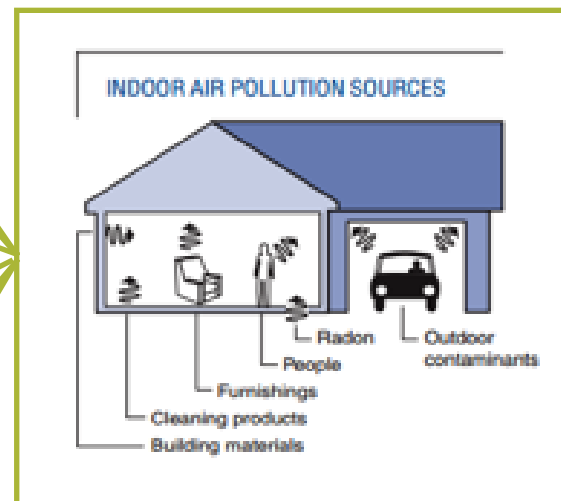
- No VOC paint
- Composite wood materials with low-formaldehyde emissions

Radon Control

- Form-A-Drain for footings

Overall HVAC

- Filtration

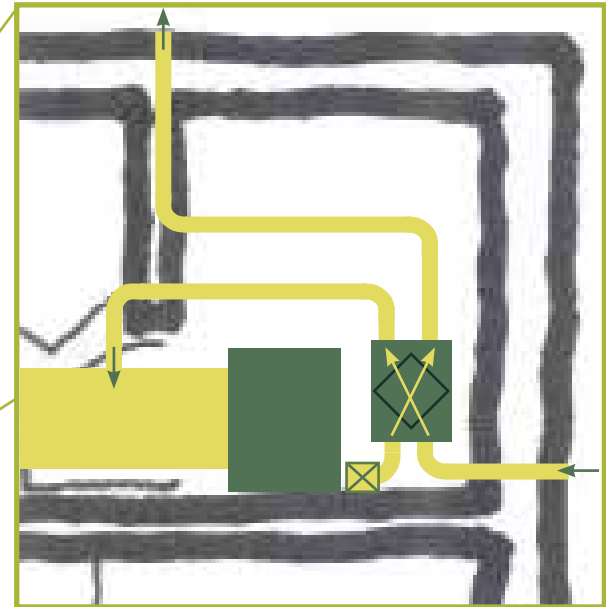
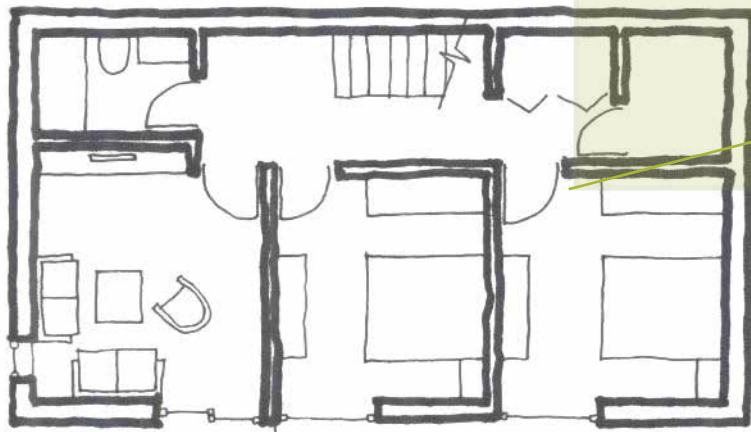




O5 // VENTILATION SYSTEM



Panasonic WhisperGreen



Mechanical Room Plan



Fantech



06 // EQUIPMENT SELECTION

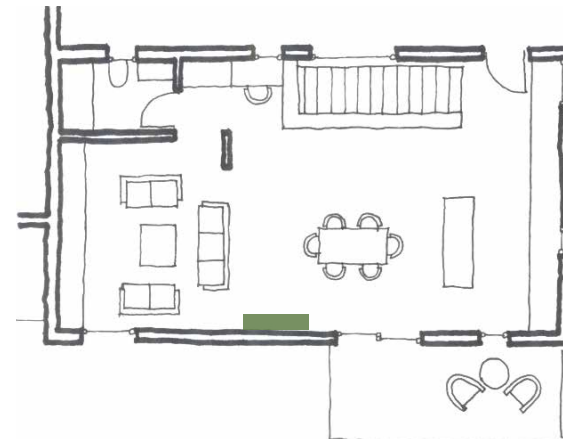


Fujitsu AOU9RLFC

	Ducted Unit	Wall Mounted Unit
Model Number	AOU9RLFC	AOU9RLS3
Cooling Capacity	9000 Btuh	9000 Btuh
Heating Capacity	12000 Btuh	12000 Btuh
SEER	21.5	33
HSPF	12.2 Btu/hW	14.2 Btu/hW
Sound Pressure Level	49 dB	42 dB



Fujitsu AOU9RLS3



MATT ROOKE



BRIAN AULT



ANDREW
POERSCHKE



06 // HEATING LOADS

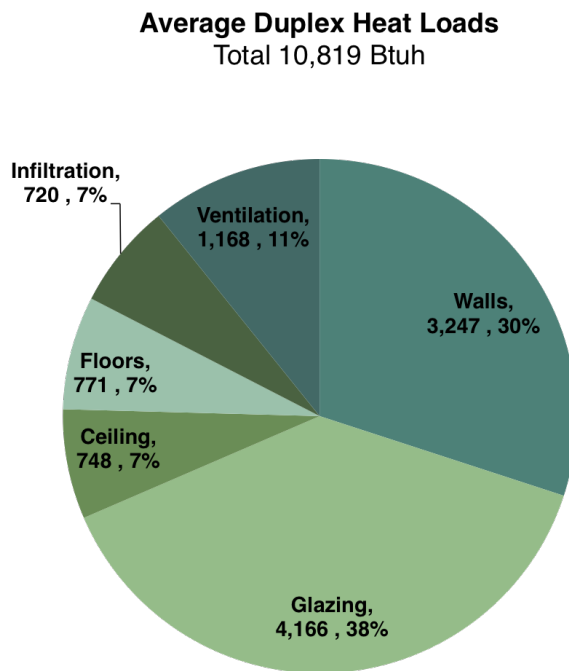


Figure 06.3.2 – Entire house average heating % of load

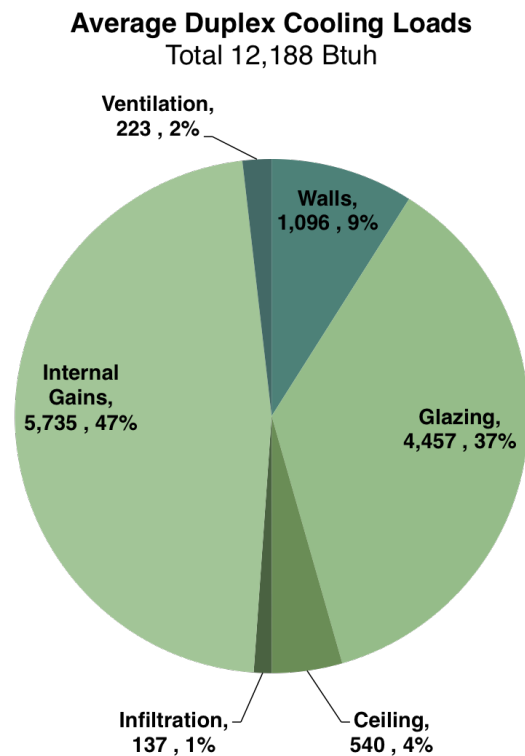
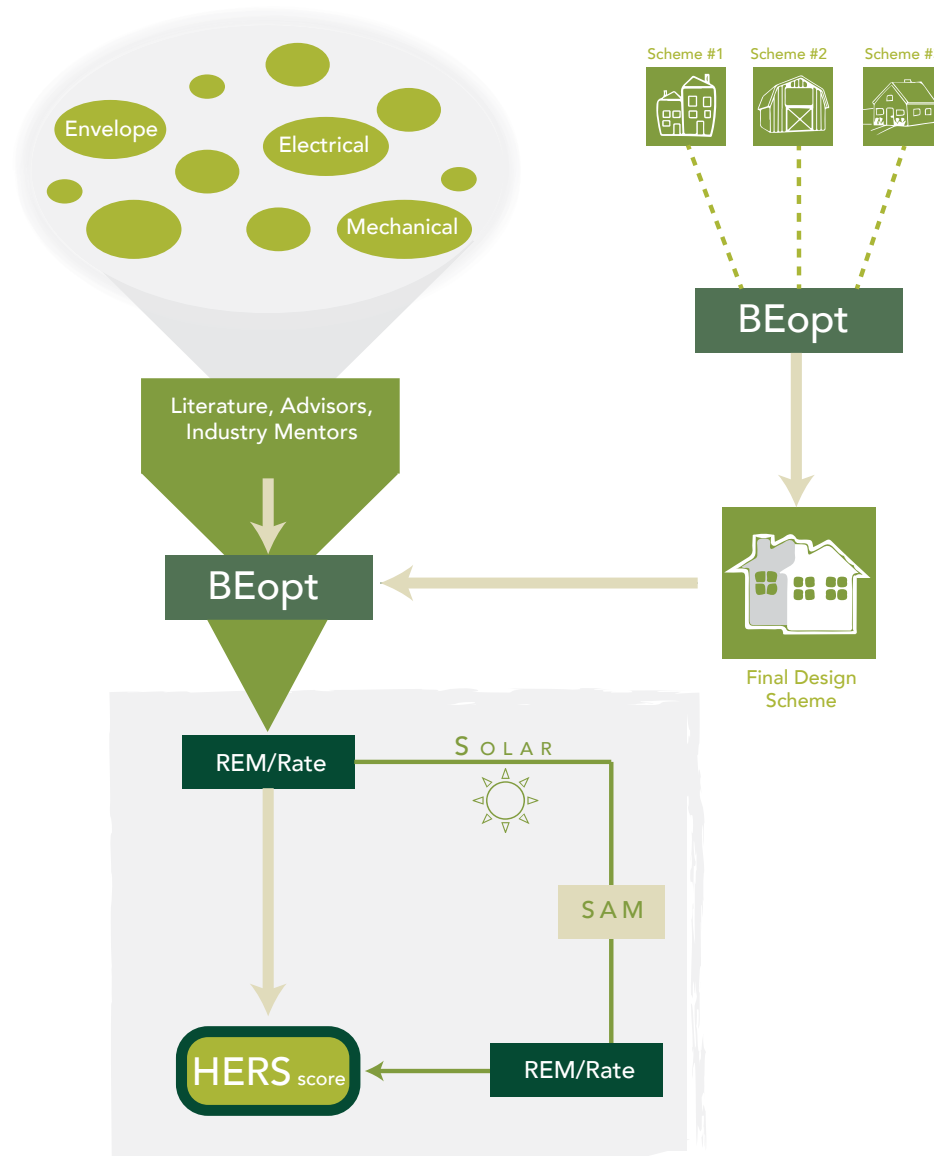


Figure 06.3.3 – Entire house average cooling % of load

Even though mechanical system may be slightly oversized, the mini splits have variable speed air handler and compressor which can modulate down to the lower required loads.



07 // ENERGY ANALYSIS



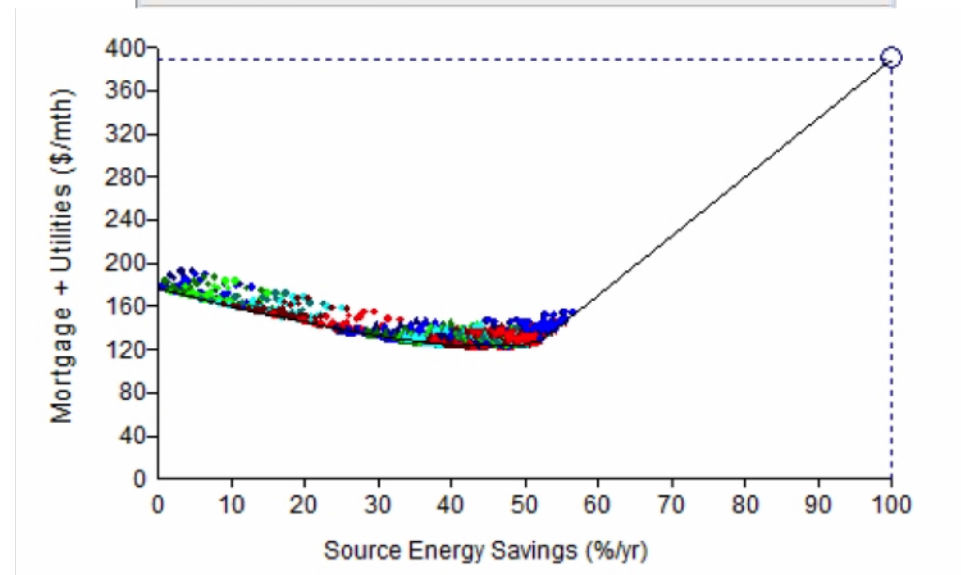
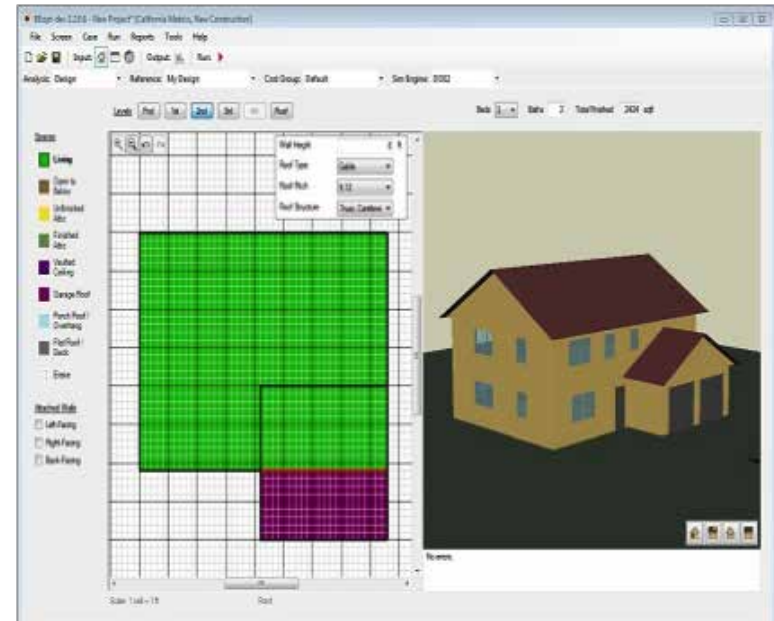
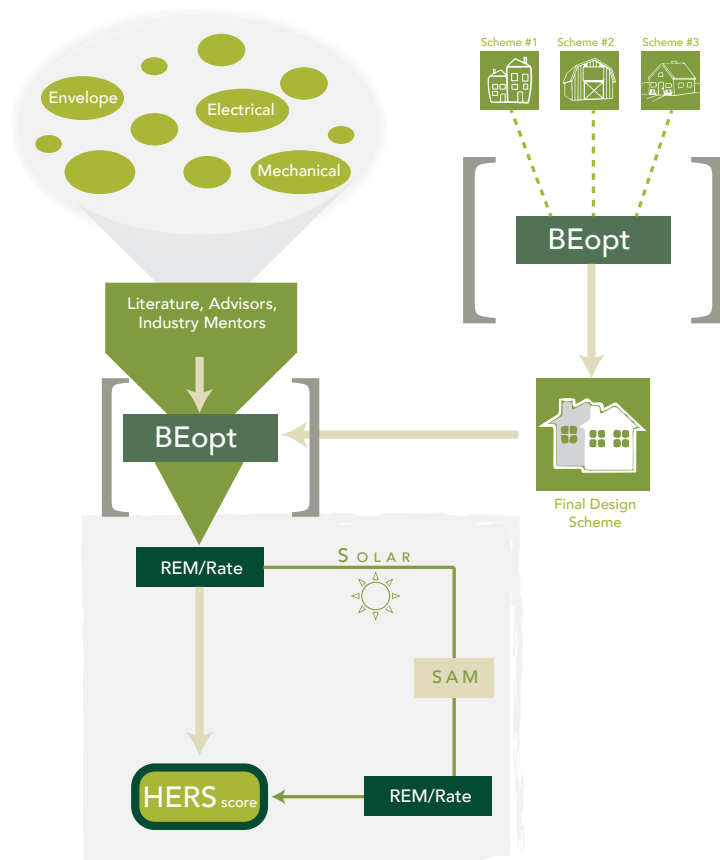
PETER VARGO



Figure 07.0.1 – Energy analysis process

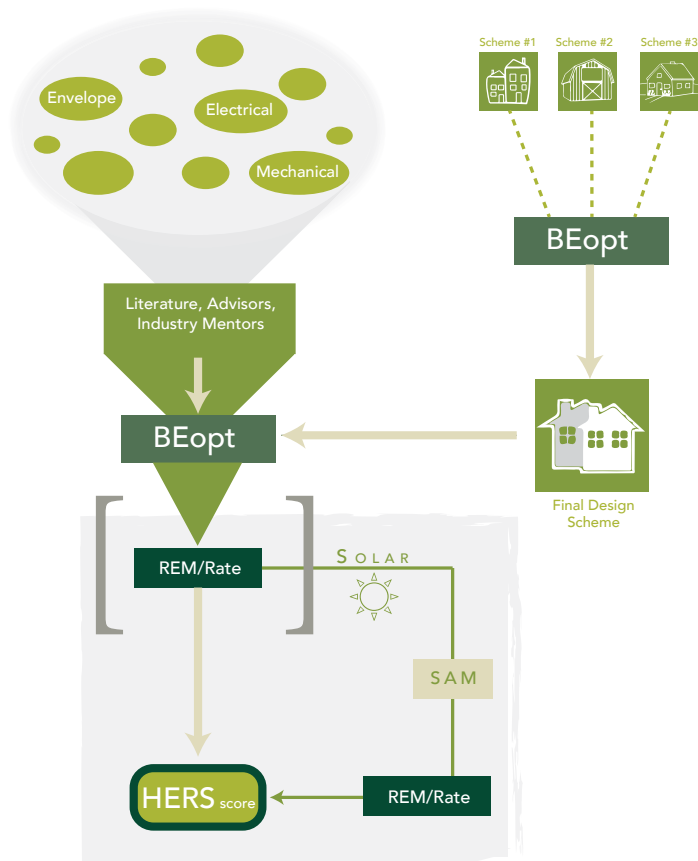


07 // BE_{OPT}





07 // REM/RATE



ENERGY STAR[®] CERTIFIED NEW HOME

Projected Rating: Based on Plans - Field Confirmation Required.

Builder Name:
Permit Date/Number:
Home Address: 1394 University Drive
University Park, PA 16803

Rating Company: Pennsylvania State University
Rater Identification Number:
Rating Date:
Version: 3.0

Standard Features of an ENERGY STAR Certified New Home

Your ENERGY STAR certified new home has been designed, constructed, and independently verified to meet rigorous requirements for energy efficiency set by the U.S. Environmental Protection Agency (EPA), including:

Thermal Enclosure System A complete thermal enclosure system that includes comprehensive air sealing, quality-installed insulation and high-performing windows to deliver improved comfort and lower utility bills. Air Infiltration Test: Htg: 1.00 Cig: 1.00 ACH50 Primary Insulation Levels: Ceiling: R-63.0 FndWall: R-25.0 AGWall: R-30.0 Slab: R-10.0, D-10.0 Primary Window Efficiency: U-Value: 0.300, SHGC: 0.540	Water Management System A comprehensive water management system to protect roofs, walls, and foundations. Flashing, a drainage plane, and site grading to move water from the roof to the ground and then away from the home. Water-resistant materials on below-grade walls and underneath slabs to reduce the potential for water entering into the home. Management of moisture levels in building materials during construction.
Heating, Cooling, and Ventilation System A high-efficiency heating, cooling, and ventilation system that is designed and installed for optimal performance. Total Duct Leakage: 40.00 CFM2 Duct Leakage Indoors: 0.00 CFM25 Primary Heating (System Type • Fuel Type • Efficiency): Electric, Htg: 14.2 HSPF, Cfg: 33.0 SEER. Primary Cooling (System Type • Fuel Type • Efficiency): Electric, Htg: 14.2 HSPF, Cfg: 33.0 SEER.	Energy Efficient Lighting and Appliances Energy efficient products to help reduce utility bills while providing high-quality performance. ENERGY STAR Lighting: 100% ENERGY STAR Qualified Appliances and Fixtures: Dishwashers Cellular Fans Exhaust Fans Primary Water Heater (System Type • Fuel Type • Efficiency): Heat pump, Electric, 3.10 EF, 50.0 Gal.

HERS[®] Index

Zero Energy Home Reference Home Existing Homes

Less Energy More Energy

This Home: **38**

The certificate provides a summary of the major energy efficiency and other construction features that contribute to this home earning the ENERGY STAR, including its Home Energy Rating System (HERS) score, as determined through independent inspection and verification performed by a trained professional. The Home Energy Rating System is a nationally recognized uniform measurement of the energy efficiency of homes.

Note that when a home contains multiple performance levels for a particular feature (e.g., window efficiency or insulation levels), the predominant value is shown. Also, homes may be certified to earn the ENERGY STAR using a sampling protocol, whereby one home is randomly selected from a set of homes for representative inspections and testing. In such cases, the features found in each home within this set are intended to meet or exceed the values presented on this certificate. The actual values for your home may differ, but offer equivalent or better performance.

This certificate was printed using REM/Rate - v14.6.
© 1985-2015 Noreco, Boulder, Colorado.

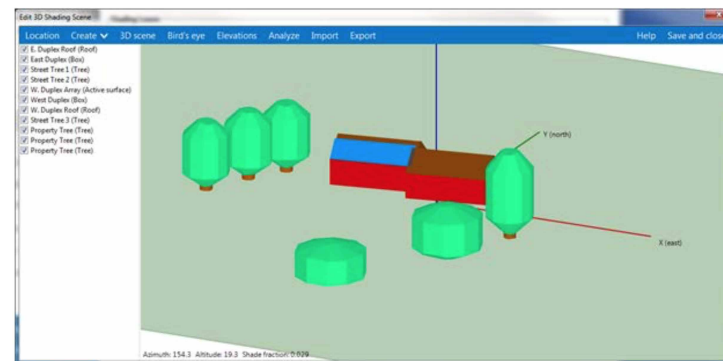
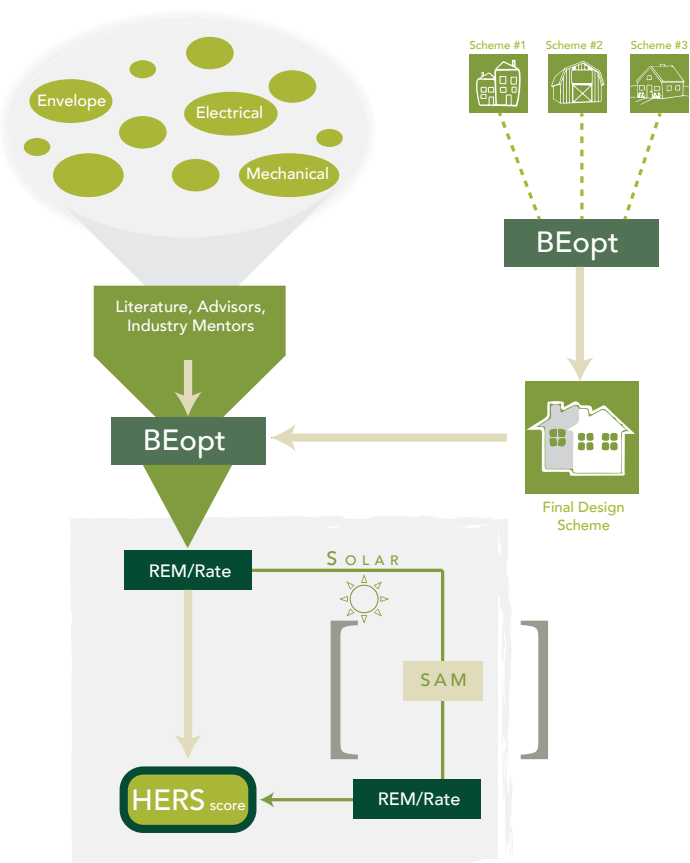
Learn more at www.energystar.gov/newhomes



07 // ENERGY ANALYSIS



JASON
GROTTINI



07 // HERS SCORE AND FINAL RESULTS

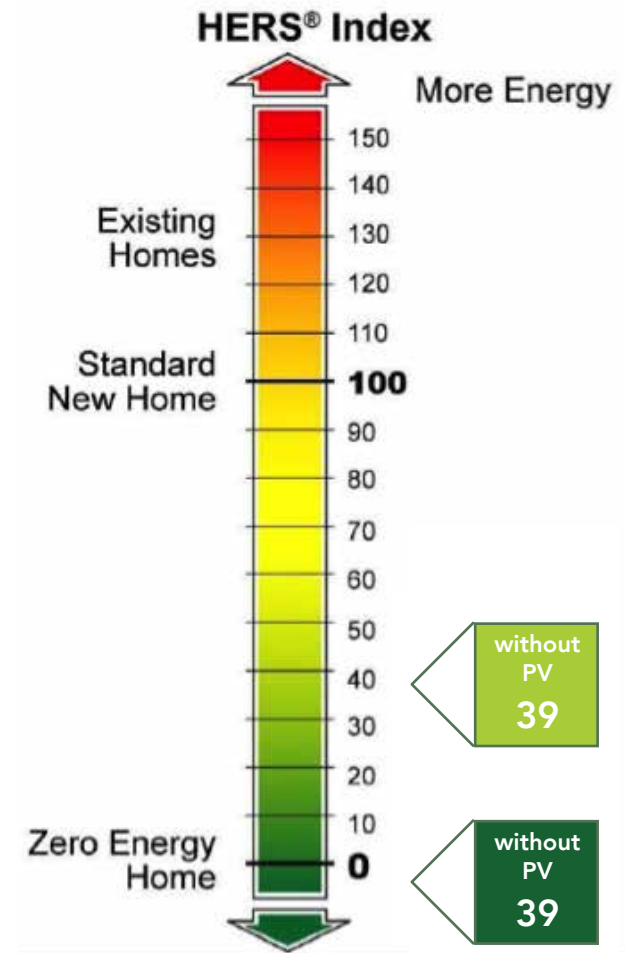
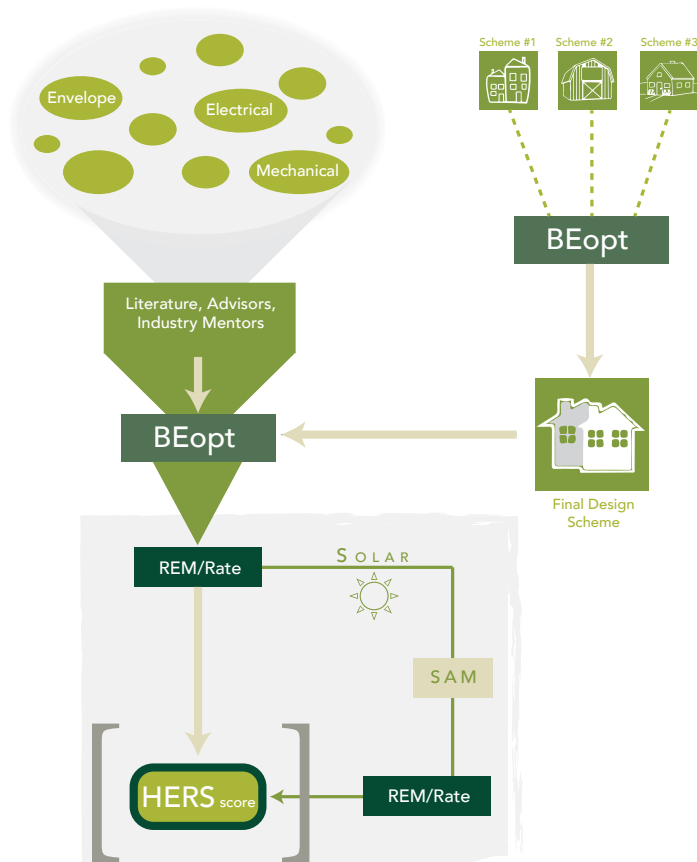


Figure 07.8.2 - HERS index score



08 // FINANCIAL ANALYSIS



Figure 08.1.3

The SCCLT signs a long-term lease with the new owner of the house assuring them that the property will remain available to them.

The new homeowner only purchases the improvements to the land.

The SCCLT purchased the land for a total of \$150,000.

Accordingly, each homeowner of the duplex saves \$75,000 dollars towards the sales price of their home.



RON QUINN



08 // FINANCIAL ANALYSIS

Competition Guidelines

Annual payments on the home must be **38%** of annual income

4.5%, 30 year fixed rate

Down Payment **20%** of house cost

Monthly household debt **0.5%** of annual income

SCCLT Guidelines

Mean Family Income (MFI) for State College **\$66,800.**

		Target Construction Cost	Target Cost Per Square Foot
MFI for State College:	\$66,800	\$ 297,000	\$ 116
High End Income Level:	\$80,160	\$ 380,160	\$ 149
Low End Income Level:	\$53,440	\$ 207,900	\$ 84

Figure 08.1.1

Design for Affordable/low income home buyers

Invest in durability



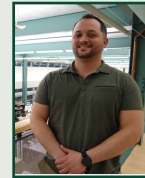
08 // CONSTRUCTION COST BREAKDOWN

ACCOUNT / DETAIL	COST	%
Site Preparation		
Water and Sewer Inspection	\$ 2,672.00	1.1%
Permits	\$ 2,111.72	0.9%
Utility Fees	\$ 7,950.00	3.2%
Landscaping	\$ 15,531.00	6.3%
Total	\$ 28,264.72	11%
Foundation		
Excavation and Backfill	\$ 16,000.00	6.5%
Underslab Plumbing	\$ 300.00	0.1%
Footings and Slab	\$ 14,248.00	5.8%
Insulation and Durability	\$ 1,757.00	0.7%
Drain	\$ 498.40	0.2%
Total	\$ 32,803.40	13.2%
Framing		
Floor Framing	\$ 4,335.64	1.7%
Roof Framing	\$ 7,600.00	3.1%
Wall Framing	\$ 14,197.60	5.7%
Bracing, blocking and waste	\$ 1,000.00	0.4%
Patio	\$ 3,913.84	1.6%
Framing Labor	\$ 20,480.00	8.3%
Total	\$ 51,527.08	20.8%
Envelope		
Sheathing	\$ 2,004.00	0.8%
Insulation	\$ 8,320.23	3.4%
Windows and Exterior Doors	\$ 7,514.00	3.0%
Rental and Disposal Fees	\$ 275.00	0.1%
Total	\$ 18,113.23	7.3%

ACCOUNT / DETAIL	COST	%
Exterior Finish		
Roofing	\$ 10,899.95	4.4%
Wall Finishes	\$ 6,673.00	2.7%
Gutters and Downspouts	\$ 488.00	0.2%
Total	\$ 18,060.95	7.3%
Interior Finish		
Drywall and Paint	\$ 14,196.64	5.7%
Flooring	\$ 8,357.21	3.4%
Interior Finishes, Doors, and Trim	\$ 2,821.20	1.1%
Lighting Fixtures	\$ 10,323.30	4.2%
Plumbing Fixtures	\$ 5,517.40	2.2%
Cabinetry	\$ 8,316.00	3.4%
Appliances	\$ 4,034.09	1.6%
Interior Labor	\$ 3,840.00	1.5%
Total	\$ 57,405.84	23.2%
MEP		
Mechanical	\$ 19,605.00	7.9%
Electrical	\$ 13,000.00	5.2%
Plumbing	\$ 9,000.00	3.6%
Total	\$ 41,605.00	16.8%
Subtotal	\$ 247,780.22	100.0%
Company Expenses		
Overhead and Profit	\$ 49,556.04	20.0%
Sales Tax	\$ 12,389.01	5.0%
TOTAL COST		\$309,725.28



MICHELLE
PALM



CHAD OWENS



GREG BALLAS



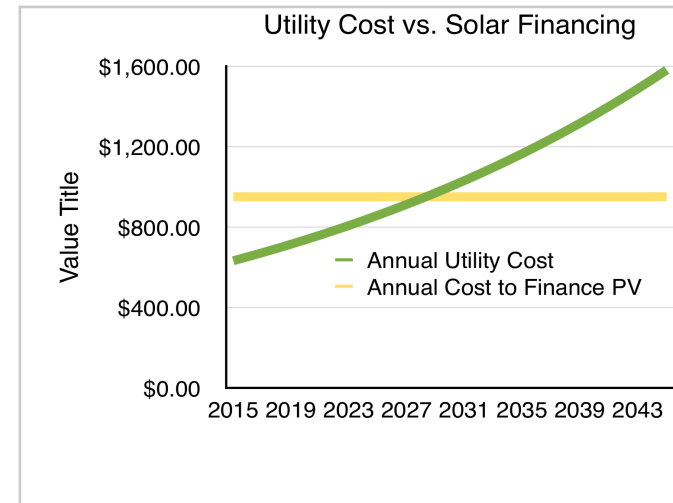
Figure 08.3.1

08 // FINANCING SOLAR PV

Consideration for Future Energy Rates

Total kW Output of PV Array	\$/kWh	Annual Savings	Payback Timeline
7,628	\$0.122	\$930.62	30 years

Figure 08.5.1



Financing the Home With and Without PV

	PV Loan Type	Home Sales Price	Monthly Cost of Home	Monthly Cost of PV (20 yrs)	Annual Cost	% of Income
Cost of Land Included	PV integrated in mortgage	\$275,294.74	\$ 1,618.35	N/A	\$23,428.20	35.07%
	Home equity loan	\$247,349.77	\$ 1,457.63	\$ 294.77	\$25,036.80	37.48%
Cost of Land Excluded	PV integrated in mortgage	\$200,294.74	\$ 1,186.99	N/A	\$18,251.88	27.32%
	Home equity loan	\$172,349.77	\$ 1,026.27	\$ 294.77	\$19,860.48	29.73%

Figure 08.1.4



JASON
GROTTINI



08 // FINANCIAL ANALYSIS

Home Sale Breakdown / PV Integrated into the Mortgage

1) House Cost	
Home Value	\$200,258.74
Down Payment	\$ 40,051.75
Amount Financed	\$160,206.99

2) House Financing	
<i>Interest Rate</i>	4.5%
<i>Loan Period</i>	30
Loan Payment	\$ 811.75
Monthly Taxes	\$ 310.00
Home Insurance	\$ 65.00
Household Debt	\$ 334.00
Total Payment	\$ 1,520.75

3) Debt to Income Ratio	
2013 State College MFI	\$ 66,800.00
Monthly Income	\$ 5,566.67
% Gross Income	27.32%

08 // FINANCIAL ANALYSIS

Home Sale Breakdown / PV Integrated into the Mortgage

1) House Cost	
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09 // DOMESTIC HOT WATER



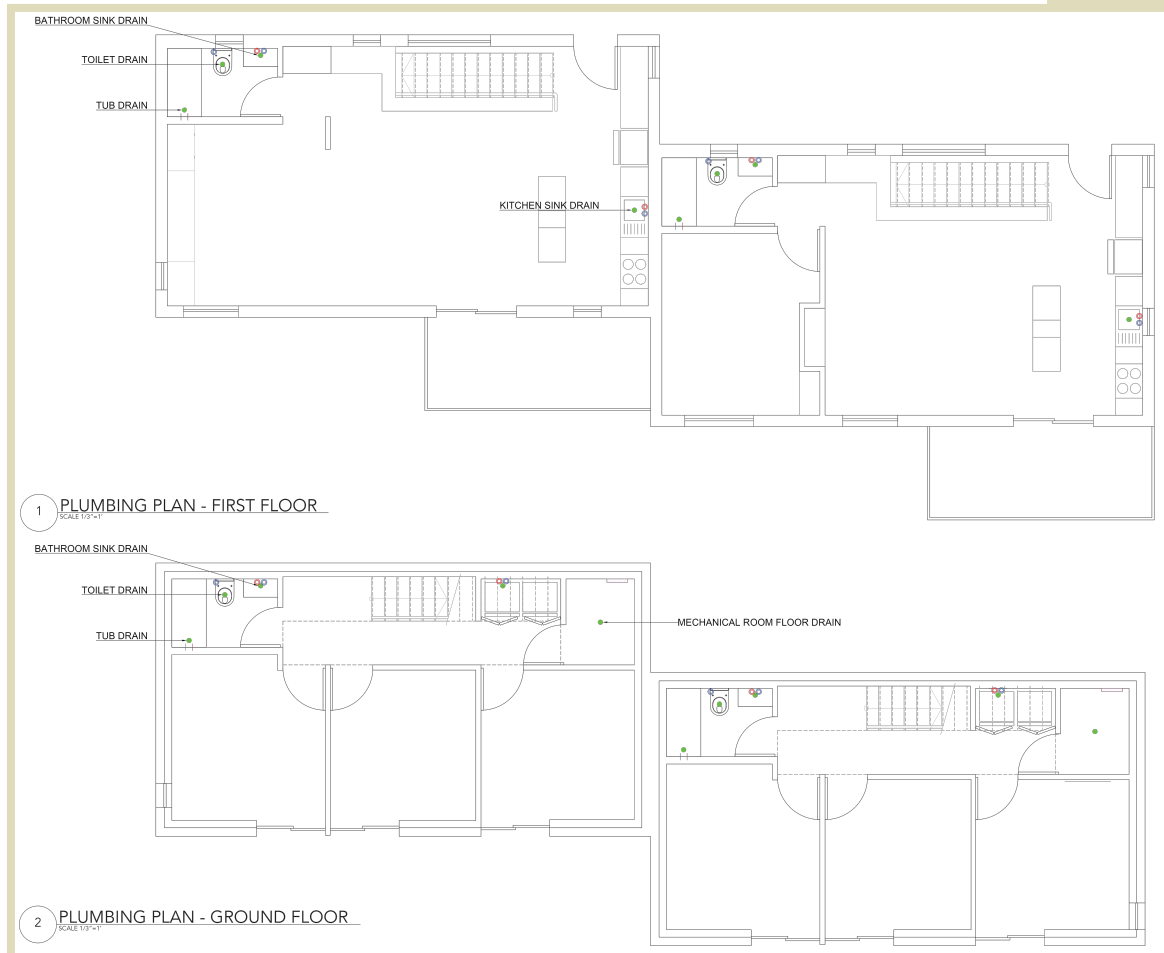
PETER VARGO



Figure 09.1.1 Domestic Water Heater [1]



Figure 09.1.2



Plumbing Floor Plans

Water Heater
Model
GEH50DFEJSR

-50 Gallon Capacity

-3.1 Energy Factor

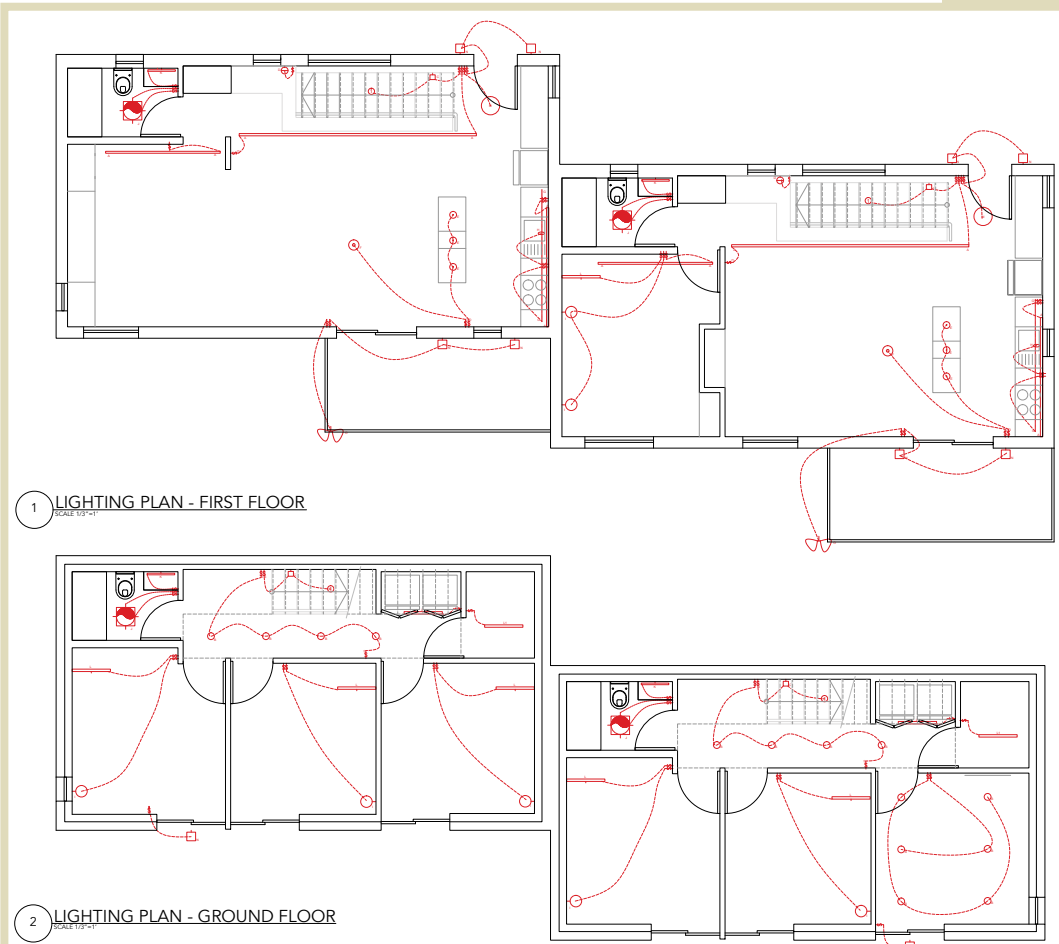
-Abundant hot water
with 67 gallons first-
hour delivery.

-Electric controls with
4 modes including a
vacation setting

-Limited 10 year
warranty



09 // LIGHTING



Lighting Floor Plans



MICHELLE
PALM



RICHARD
MISTRICK PhD



GARY
GOLASZEWSKI



- Natural Daylighting
- All LED and
Fluorescent Fixtures



09 // APPLIANCES

Appliance	Size	ENERGY STAR	Price	Characteristics
Range	30 in	N/A	\$ 549.99	GE, Model JBP23SRSS, Stainless Steel
Range Hood	30 in	N/A	\$ 199.00	GE Convertible, Model JV347HBB, Black
Microwave	1.1 Cu.Ft.	N/A	\$ 139.00	LG Electronics, Model LCS1112ST, Stainless Steel
Dishwasher	24 in	Yes	\$ 629.10	LG Electronics, Model LDS5040ST, Stainless Steel
Refrigerator	23.8 Cu.Ft.	Yes	\$1,079.00	LG, Model LTCS24223S, Stainless Steel
Washer	4.3 Cu.Ft.	Yes	\$ 719.00	LG, Model WM3170CW, Stackable
Dryer	7.4 Cu.Ft.	Yes	\$ 719.00	LG, Model DLE3170W, Stackable





10 // INDUSTRY PARTNERS


CHAD OWENS

Name of Company: Timber Rock Homes

Title of Contact: Owner

Credentials: Professional Engineer, NAHB Certified Green Professional, and owner of Timber Rock Homes in Bellefonte, Pennsylvania aided in the development of cost estimating.


PETER VARGO

Name of Company: Nu-Tech Energy Solutions

Title of Contact: President/Owner

Credentials: Building Performance consultant & Energy Rater who has carved out a niche in the affordable housing industry over the last 10 years who consulted with the team on energy modeling and calculations.


RON QUINN

Name of Company: State College Community Land Trust

Title of Contact: Executive Director

Credentials: With more than 15 years of experience in professional performance with pride and integrity for the State College community, Ron served as the primary contact between the Penn State team and the State College Community Land Trust during the competition.


JASON GROTTINI

Name of Company: Envinity, Inc.

Title of Contact: Director of Operations and Business Development

Credentials: Jason received a Master of Science degree from Penn State University in Environmental Pollution Control Engineering and with years of energy consulting experience helped the team with solar technology cost estimating.


MATT ROOKE

Name of Company: Envinity, Inc.

Title of Contact: Consulting Engineer

Credentials: As a HVAC Engineer & Building Energy Analyst, he helped the Penn State team develop cost estimates and designs for the mechanical system.


MICHELLE PALM

Name of Company: The HITE Company

Title of Contact: Lighting Design Consultant

Credentials: Professional lighting design consultant with more than 10 years of experience, provided the team with cost estimates for light fixtures used in the home.


GREG BALLAS

Name of Company: YBC

Title of Contact: Sales Consultant

Credentials: Greg has more than 15 years of experience in sales and aided in cost estimating.


GARY GOLASZEWSKI

Name of Company: The Pennsylvania State University

Title of Contact: Associate Professor

Credentials: An award winning lighting designer with 12 years of professional experience helped the lighting team with codes and developing electrical plans.


RICHARD MISTRICK PHD

Name of Company: The Pennsylvania State University

Title of Contact: Instructor

Credentials: With a doctorate in Illuminating Engineering, Dr. Mistrick helped the lighting team with day lighting calculations.


BRIAN AULT

Name of Company: Karpinski Engineering

Title of Contact: Project Engineer

Credentials: Brian is a Professional Engineer with 7 years of experience as a Mechanical Engineer and is an advisor to the mechanical team.


ANNE MESSNER

Name of Company: Borough of State College

Title of Contact: Senior Planner

Credentials: Anne is the planning and zoning officer for the borough of State College, PA who worked with the State College Community Land Trust and the Penn State team to discuss zoning requirements.


TOM FOUNTAINE

Name of Company: Borough of State College

Title of Contact: Borough Manager

Credentials: As past President of the International Town & Gown Association and current Borough Manager for State College, PA, Tom helped the Penn State team with tax assessments required for the competition report.


SCOT CHAMBERS

Name of Company: Keller Williams Advantage Realty

Title of Contact: Realtor

Credentials: Specializing in residential and land sales and purchasing for central Pennsylvania, Scot helped the State College Community Land Trust and the Penn State team with locating an appropriate site for the duplex.


ANDREW POERSCHKE

Name of Company: IBACOS

Title of Contact: Building Performance Specialist

Credentials: Andrew aided in the design and performance of the mechanical system as well as the building envelope of the duplex.





11 //PROJECT SUMMARY

Project Data



- Location: 1394 University Drive, State College, PA 16801
- Climate Zone: 5
- Square Footage: 1,440 ft² per duplex (2,880 ft² total)
- Number of bedrooms: 3 per duplex
- Number of bathrooms: 2 full bathrooms per duplex
- Number of stories: 1 story with full basement per duplex
- HERS score without PV: 39
- HERS score with PV: -3
- Estimated monthly energy cost without PV: \$78.96 @ \$0.12 per kWh
- Estimated monthly energy cost with PV: - \$1.70 @ \$0.12 per kWh

Technical Specifications

- Walls Effective R-value =29
- Foundation Wall Effective R-value = 23
- Slab Insulation = R-10
- Roof Insulation = R-60
- Window Performance
 - South & East Windows:
U=0.29, SHGC = 0.500
 - North & West Windows:
U=0.24, SHGC = 0.260
- HVAC specifications
 - Heating/Cooling/Ventilation:
 - Basement and First Floor Bedroom: (1) ¾ ton, 24 SEER, 13 HSPF ducted Mini Split Heat Pump,
 - First Floor Main Space: (1) ¾ ton, 33 SEER, 14.2 HSPF wall mounted Mini Split Heat Pump
 - Water Heating: 50 gallon heat pump water heater



HERITAGE HOMES
H4: High Performance Living
in Harmony with Community

