Designing the Cross Street Passive House

Performance, Resilience and Certification

phius con
MILWAUKEE 2025

Speakers

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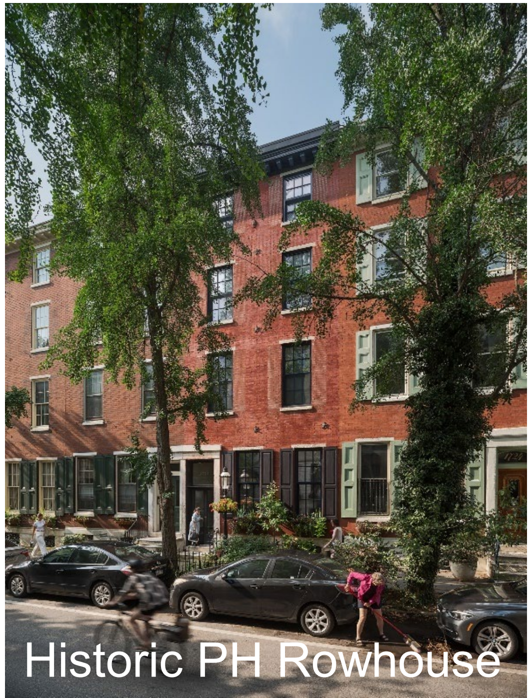
Learning objectives

1. Identify potential building science, health, and wellness issues in urban passive building retrofits.
2. Discuss resiliency challenges and solutions for buildings in dense urban areas.
3. Understand the role of life cycle carbon and cost analysis in guiding design decisions.
4. Outline the goals of passive building and the impact on retrofit design.

Italian Market Passive House

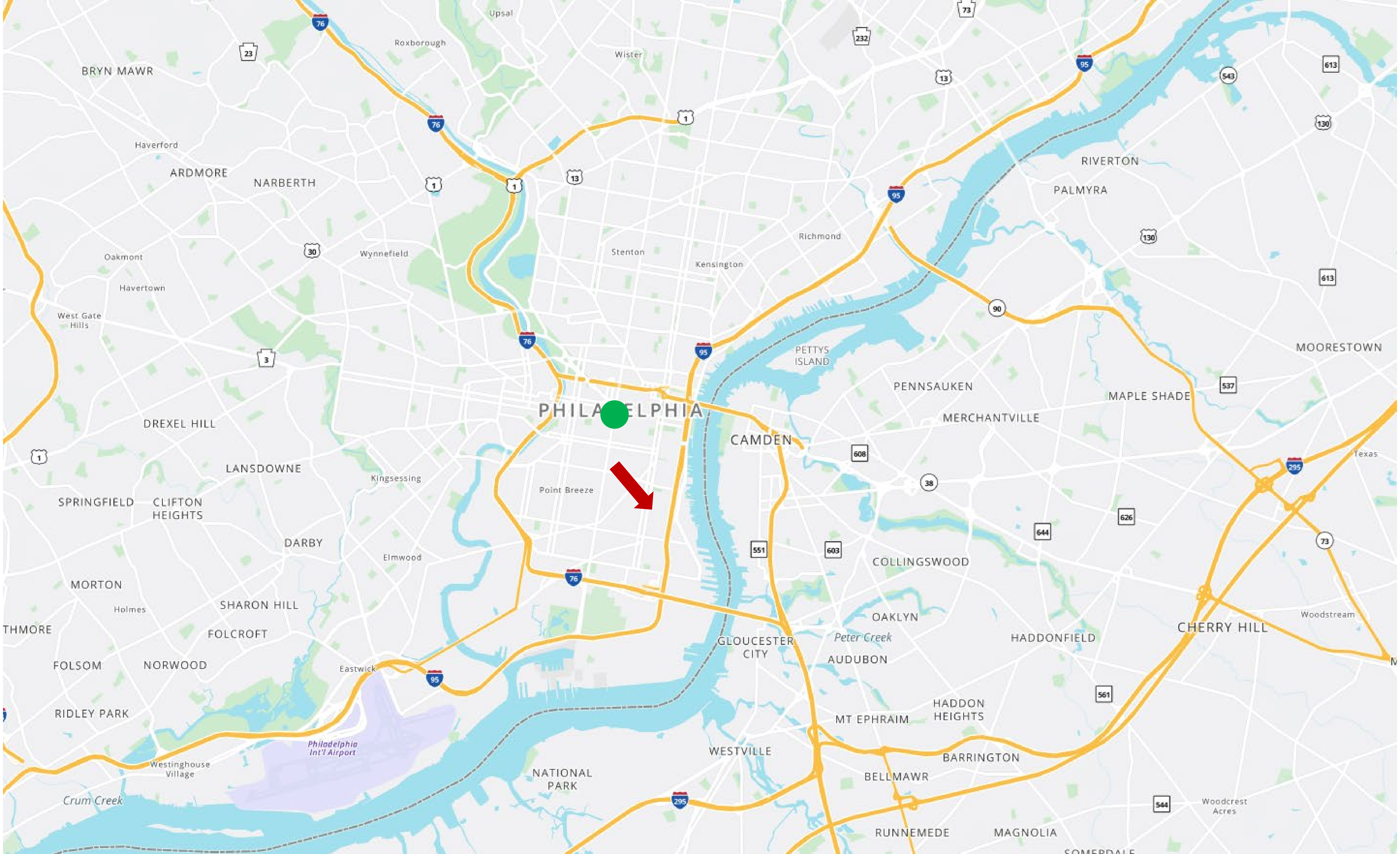
Accessible Historic Masonry PH Rehab

Bardin Passive House



Historic PH Rowhouse


CROSS STREET
PASSIVE HOUSE



PHILADELPHIA
CAMDEN
BRYN MAWR
Haverford
ARDMORE
NARBERTH
Upsal
Roxborough
Wister
Stenton
Kensington
Richmond
Wynnefield
Oakmont
Havertown
West Gate Hills
DREXEL HILL
LANSDOWNE
Kingsessing
Point Breeze
SPRINGFIELD
CLIFTON HEIGHTS
DARBY
Elmwood
MORTON
Holmes
SHARON HILL
FOLCROFT
THMORE
FOLSOM
NORWOOD
Eastwick
RIDLEY PARK
Philadelphia Int'l Airport
Westinghouse Village
Crum Creek
NATIONAL PARK
WESTVILLE
GLOUCESTER CITY
AUDUBON
OAKLYN
Peter Creek
COLLINGSWOOD
HADDONFIELD
HADDON HEIGHTS
MT EPHRAIM
BARRINGTON
BELLMAWR
RUNNEMEDE
MAGNOLIA
PETTYS ISLAND
PENNSAUKEN
MERCHANTVILLE
MAPLE SHADE
MOORESTOWN
RIVERTON
PALMYRA
CHERRY HILL
Woodstream
Texas
Woodcrest Acres


409
L+I

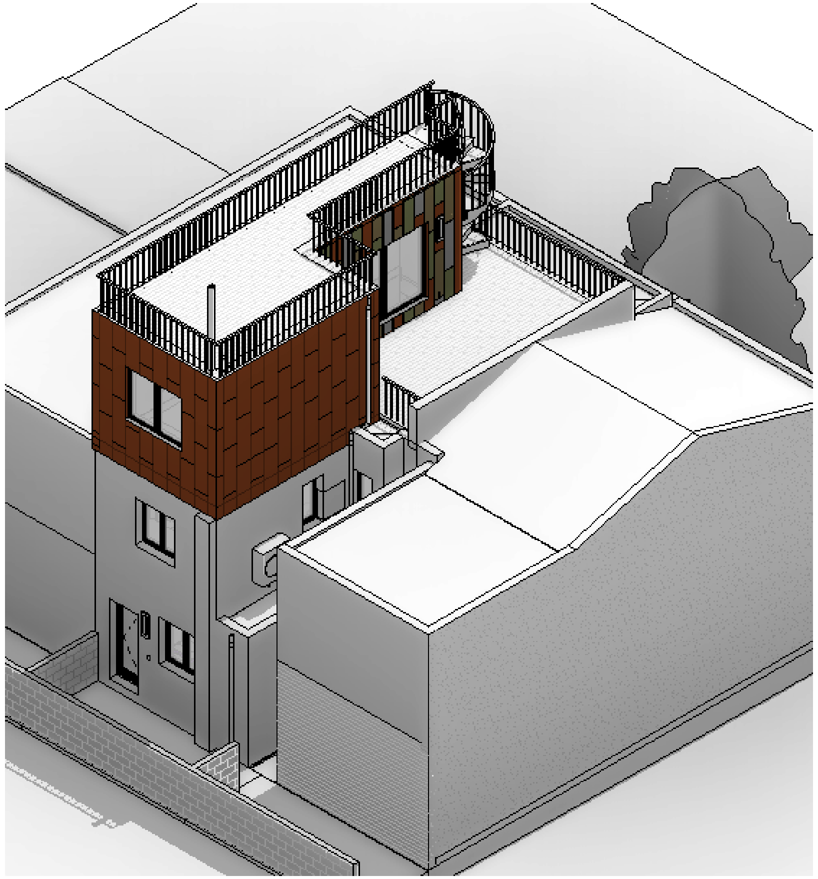
Basement

First Floor

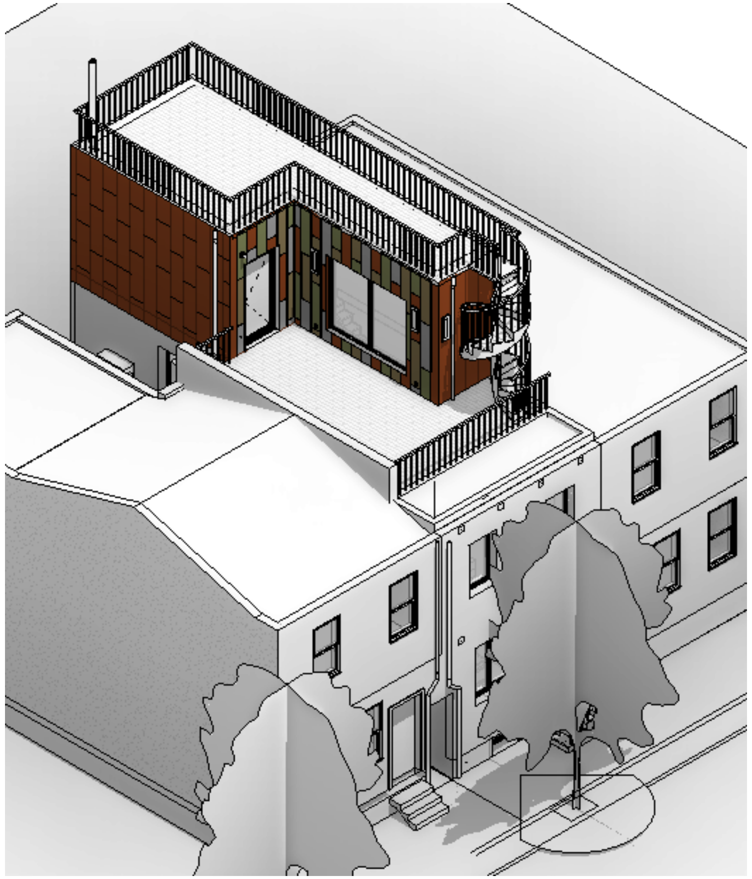
Second Floor

PROJECT INFORMATION

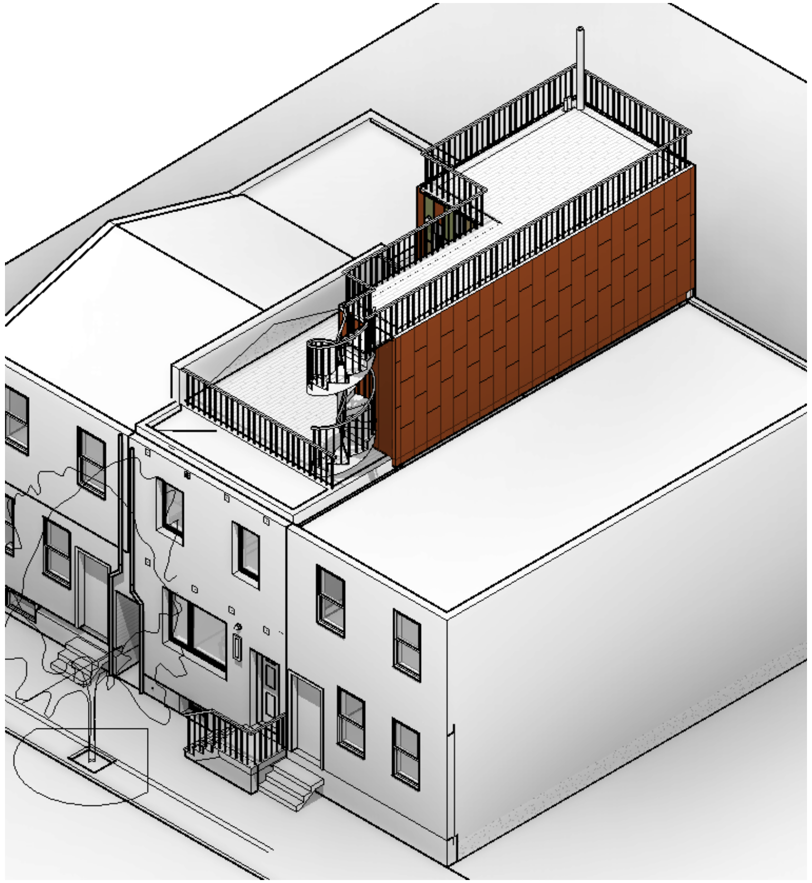
- 2-Story brick rowhouse, built ca.1910
- Rear kitchen addition, plus other changes ca. 1950
- South Philly Dickinson Square neighborhood
- Front faces south
- Lot = 16ft wide x 48-6 deep = 768sf
- 984sf on two floors, with unfinished basement (low head height)
- Fire damage May 2023
- Proposed third floor addition with walk-out deck adds 270sf
- Zoned RSA5 allows 38ft max height, roof deck with 5ft setback from front, rear yard = 9ft min or 20% of lot depth.
- Philadelphia building code = 2018 IRC
- Phius performance and certification



Rear



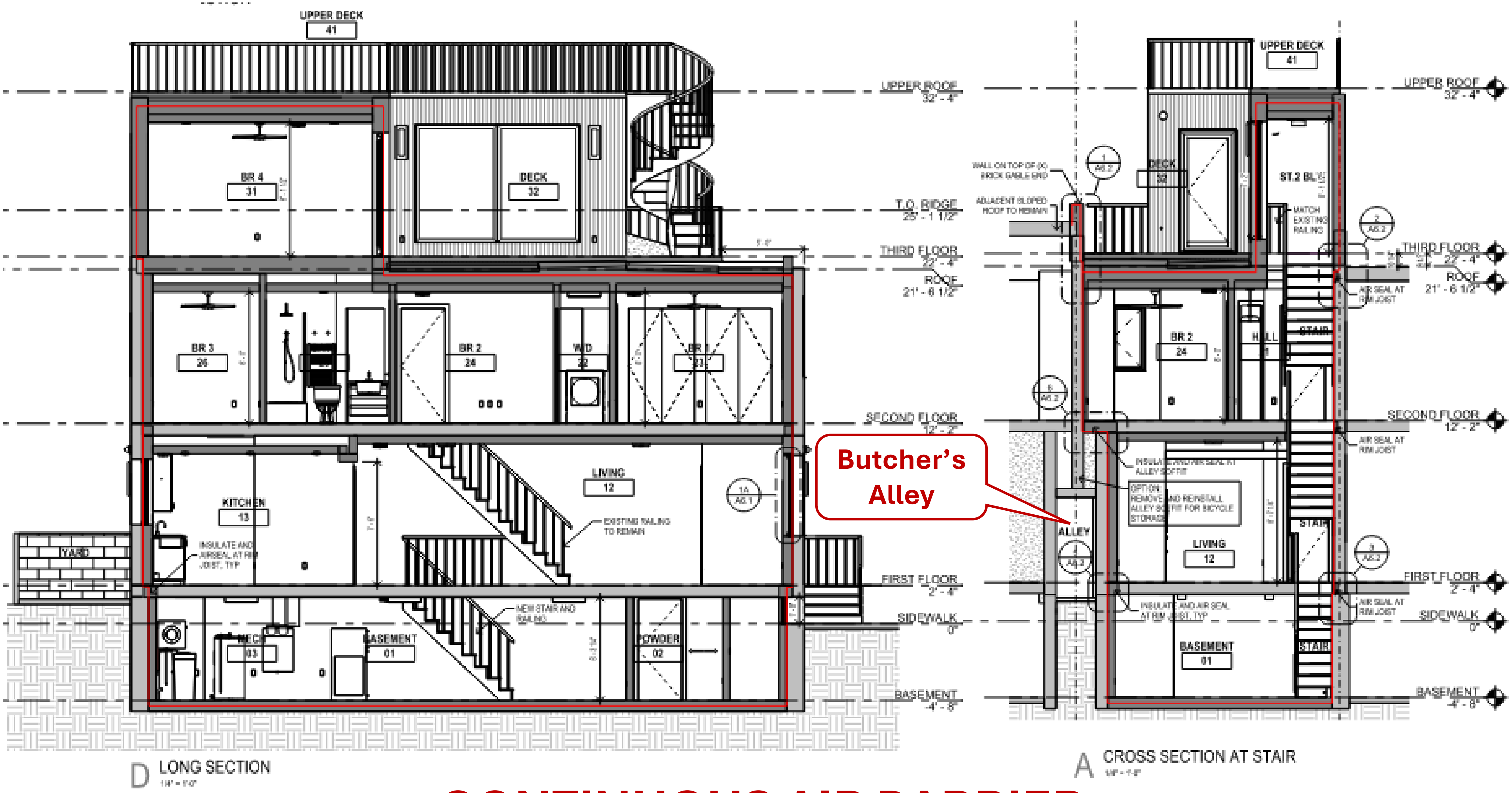
Front



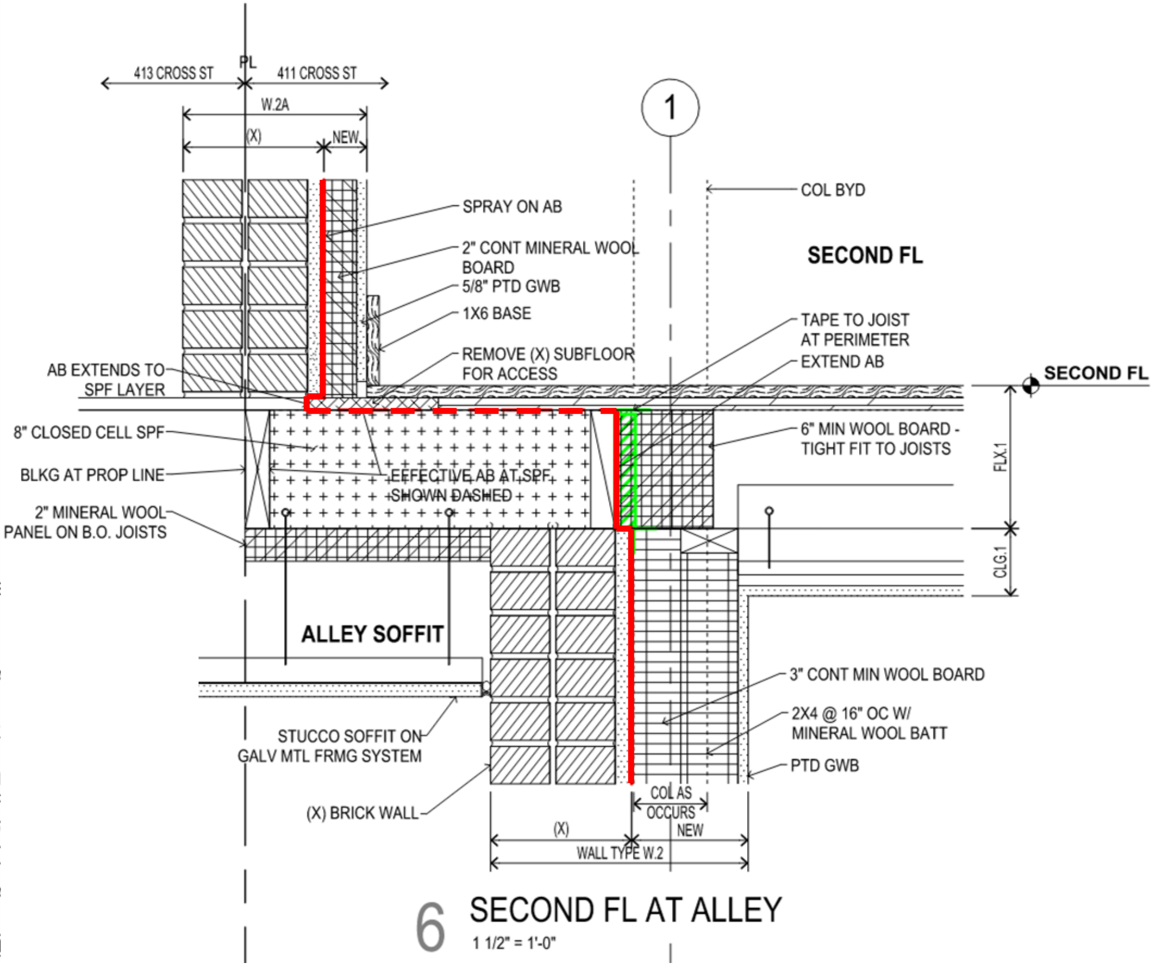
Party Wall

PROJECT GOALS

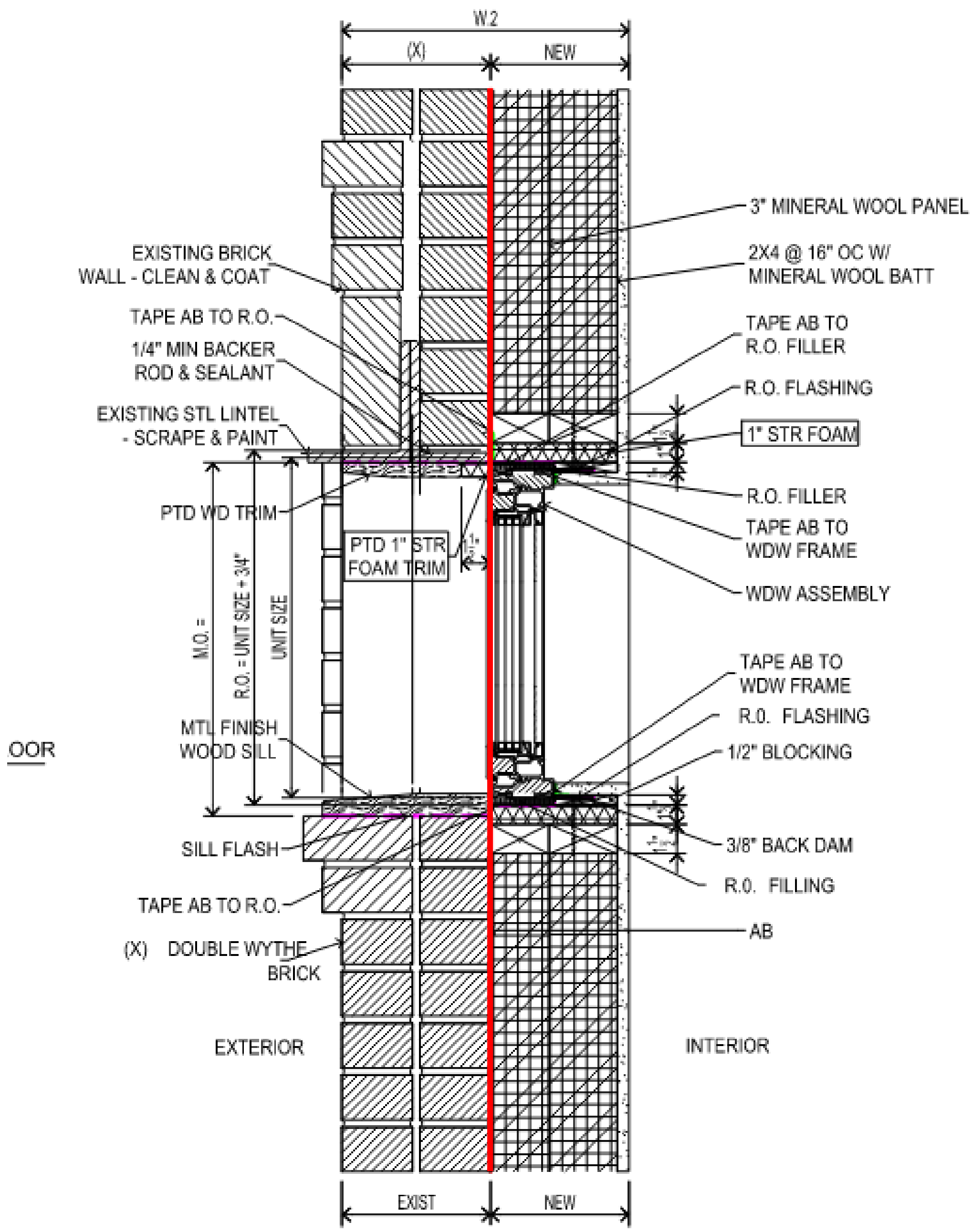
- **Foam-free** construction
- **All electric** equipment with no combustion appliances
- Continuous **HEPA filtered fresh air** through an ERV system
- **Fire-safe construction** in response to adjacent fire-damaged property
- **Existing brick** finish to remain
- **Outswing passive house windows** in existing masonry openings
- **Wood fiber insulation** where possible
- ~~Retain existing basement slab and stair~~ **New insulated slab**
- **Retain masonry and wood structure** where possible (reduce embodied carbon)
- **Add third floor with walk-out roof deck** to provide usable outdoor space.
- **Phius** certification
- **LEED** certification
- **Outreach and education**



CONTINUOUS AIR BARRIER

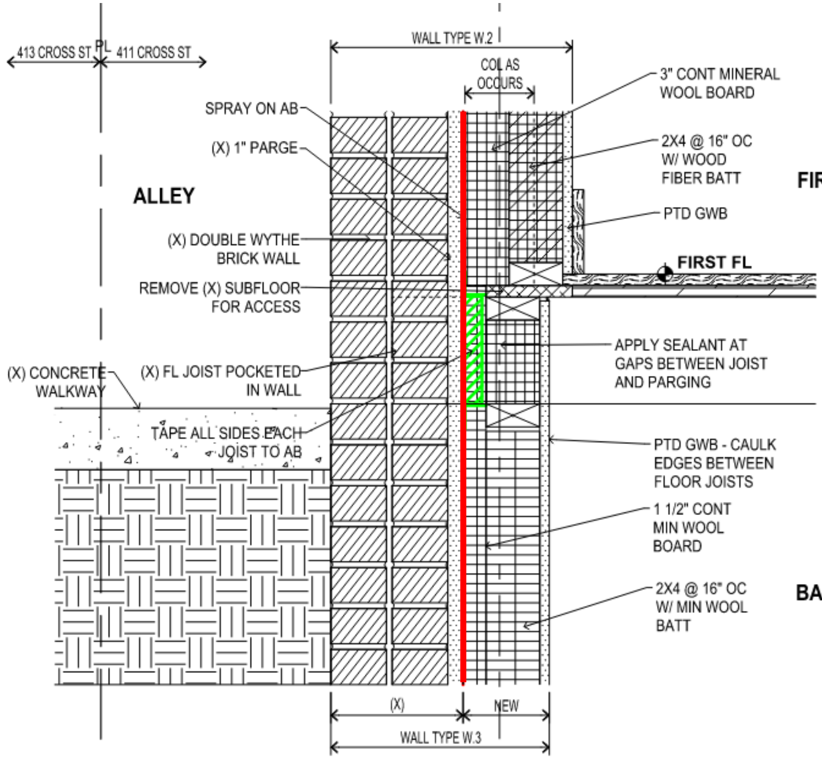


Butcher's Alley

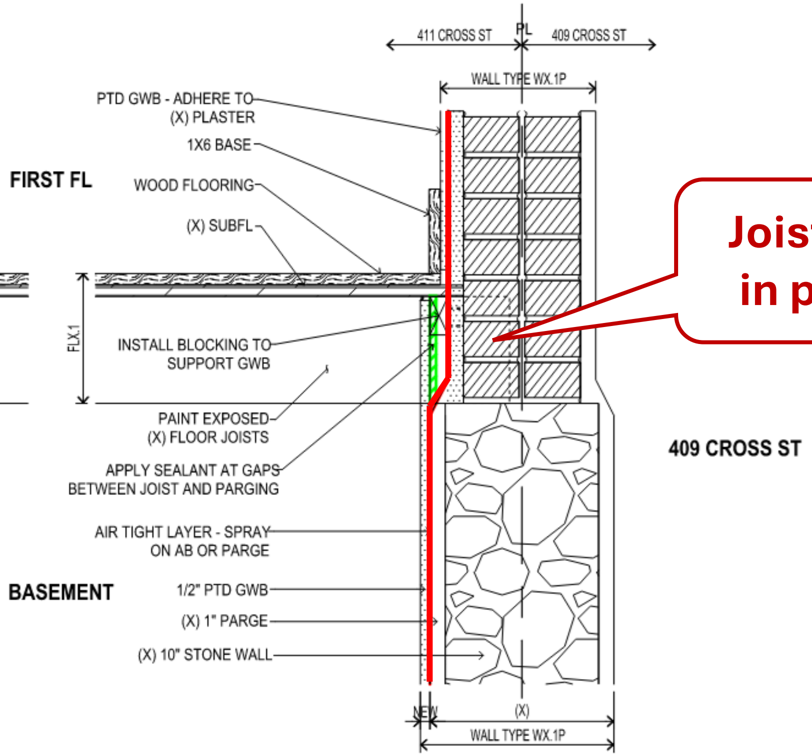


1A FRONT WINDOW SILL & HEAD

1/2" = 1'-0"



5 FIRST FL AT ALLEY
1 1/2" = 1'-0"



3 FIRST FL AT PARTY WALL
1 1/2" = 1'-0"

Joist pockets in party wall

Phius REVIVE 2024 Certification

Phius REVIVE 2021 Feasibility Study 9-18-24

WUFI Passive energy model

Phius CORE 2021 Performance

Phius REVIVE 2024 Feasibility Study 1-22-25

REVIVEcalc energy model

2021 IECC Performance

Phius 2021 Standard
Performance Requirements

Passive Conservation Criteria (Climate Specific)

Annual Heating Demand kBTU/ft^2yr

Annual Cooling Demand kBTU/ft^2yr

Peak Heating Load BTU/ft^2yr

Peak Cooling Load BTU/ft^2yr

Airtightness Requirements (per sf of gross enclosure surface area)

.060 CMF_{50}/ft^2 + .110 CMF_{75}/ft^2

Active Conservation Requirements

Net Source Energy Demand (renewable energy)

Lighting, Appliance & Equipment Efficiencies

Phius REVIVE 2024

7 Key Requirements

1. **Quality assurance / commissioning**
2. **Existing building assessment**
3. **End direct emissions** (electrify ASAP)
4. **Summer and winter resilience**, with generation / storage
5. **Repair existing hazards** - IAQ (site hazards mostly elective)
6. **Life-cycle calculations for carbon and cost** (REVIVEcalc / ADORB)

   ADORB = Annualized Decarbonization Of Retrofitted Buildings = PV / N
7. **Report project data** - cost and post-retrofit measure energy performance

Phius REVIVE 2024 FEASIBILITY STUDY

ADORB = Annualized Decarbonization Of Retrofitted Buildings = PV / N, N=70 years

Retaining masonry walls is a major embodied carbon savings, although the embodied carbon savings are not directly measured in the ADORB model, UNLESS the REVIVEcalc analysis includes these cases:

a. Rewild site
b. Retrofit to building code compliance
c. Retrofit to Phius REVIVE standard
d. Demolish and rebuild with low-carbon construction

Decarbonization: ADORB

Annualized Decarbonization of Retrofitted Buildings

Cost Metric = Sum of these annualized costs:

"FULL COST ACCOUNTING"

- Direct energy cost. e.g. site kWh * $ / kWh = $
- Direct building retrofit measures cost (material & labor)
  including building-level electrification cost. e.g. ft3 of stuff * $ / ft3 = $
- Cost of carbon -- upfront/embodied. CO_2e kg * $0.25/kg = $
- Cost of carbon – operating. CO_2e kg * $0.25/kg = $
- Energy system transition cost. Ex. new solar + storage. $/W * W = $

Criterion – Proposed cost is no greater than Baseline (existing) cost

Plus additional decarbonization effort

- Electrification, renewable sources
- Embodied carbon

FS-182 Cross St Passive House

phius — 9/19/2024

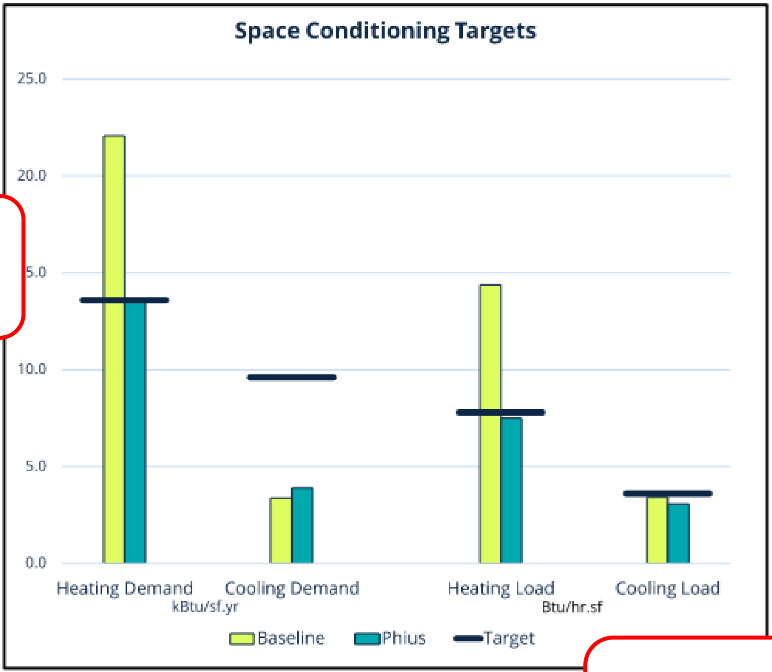
Building Information			Units
Building Address:	411 Cross Street Philadelphia, PA 19147		
Phius Climate Data Set:	Philadelphia International Airport PA		
Exterior Envelope Area:	5,264.95		ft^2
Interior Conditioned Floor Area: (iCFA)	1,671.15		
Window-to-Wall Ratio:	0.15		
Number of Stories Above Grade:	3		
Number of Dwelling Units:	1		
Number of Bedrooms:	2		
ling Information			**Units**
Fuel Type:	Electricity		
Site-to-Source Energy Factor:	1.8*		
Envelope	**2021 IECC**	**Phius CORE 2021**	**Units**
Roof:	48.5 / 0.02	48.5 / 0.02	R-value / U-value (effective)
Uninsulated Party Walls:	3.4 / 0.24	3.4 / 0.24	
Existing Above-Grade Walls:	23.2 / 0.041	33.0 / 0.029	
New 3rd Flr Above Grade Walls:	26.1 / 0.037	32.2 / 0.03	
New 3rd Flr Party Wall:	20.3 / 0.047	26.32 / 0.037	
Basement Slab:	Uninsulated	Uninsulated	
ows(Alpen Zenith):	0.155 / 0.33	0.155 / 0.33	U-value / SHGC
Fixe nith):	0.149 / 0.33	0.149 / 0.33	
Glazed doors (Ap	0.179 / 0.333	0.179 / 0.333	
Airtightness	**2021 IECC**	**Phius CORE 2021**	**Units**
Envelope Airtightness:	0.28	0.06	cfm50/ft^2 (envelope)
Lighting	**2021 IECC**	**Phius CORE 2021**	**Units**
Interior:	597		kWh/yr
Exterior:	36.7		
ances	**2021 IECC**	**Phius CORE 2021**	**Units**
	445	445	kWh/yr
asher:	270	270	
othes Washer:	120 / 0.27	120 / 2.7	kWh/yr / MEF
Clothes Dryer:	5.79	5.79	kWh/yr / MEF
Electric Loads	**2021 IECC**	**Phius CORE 2021**	**Units**
Total MELs:	1,657		kWh/yr
Ventilation	**2021 IECC**	**Phius CORE 2021**	**Units**
Continuous Ventilation:	95 / 95	60 / 60	Supply cfm / Exhaust cfm
Direct Exhaust:	200	200	Kitchen Exhaust Hood cfm
cal Systems	**2021 IECC**	**Phius CORE 2021**	**Units**
Generic ERV:	76%	84%	Sensible Recovery Efficiency
	40%	40%	Latent Recovery Efficiency
	0.50	0.50	W/cfm
Generic Heat Pump:	2.7	2.7	COP at 17F
	3.5	3.5	COP at 47F
	4	4	Annual Cooling COP
Heat Pump Water Heater:	3	3	Annual COP
	2.35	2.35	HPWH EF
WUFI Passive Results	**2021 IECC**	**Phius CORE 2021**	**Units**
Site Energy Use Intensity (EUI)	18.13	15.19	kBtu/sf
Savings over Baseline EUI	-	**16%**	
Source Energy	5,329	4,463	kWh/person.yr
Savings over Baseline Source Energy	-	**16%**	

* The site-to-source energy factor of 1.8 is used per Phius' modeling protocol. Since the same factor is used between both cases, the savings over baseline percentage remains accurate as a relative calculation.

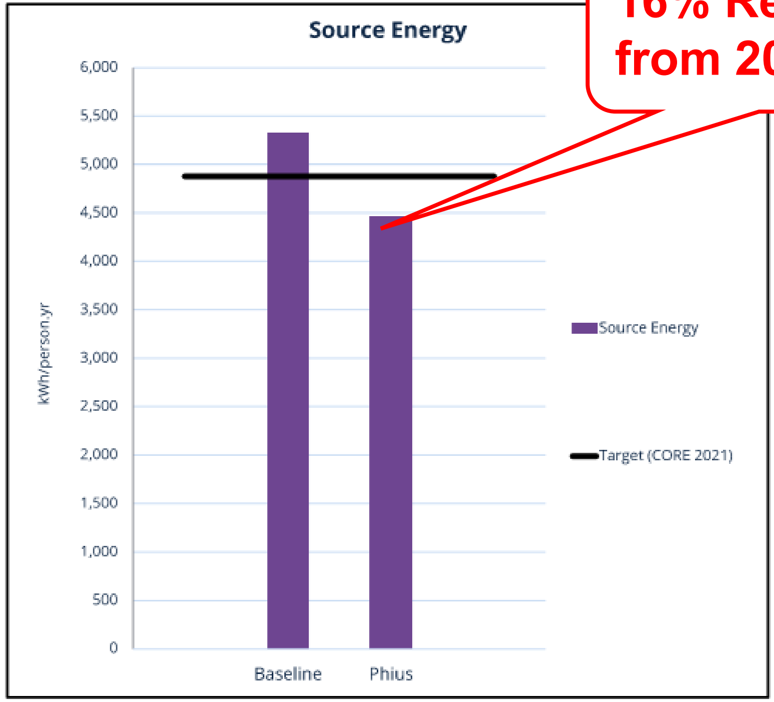
Air Tightness Reqmts
2021 IECC =
.28cfm50/sf

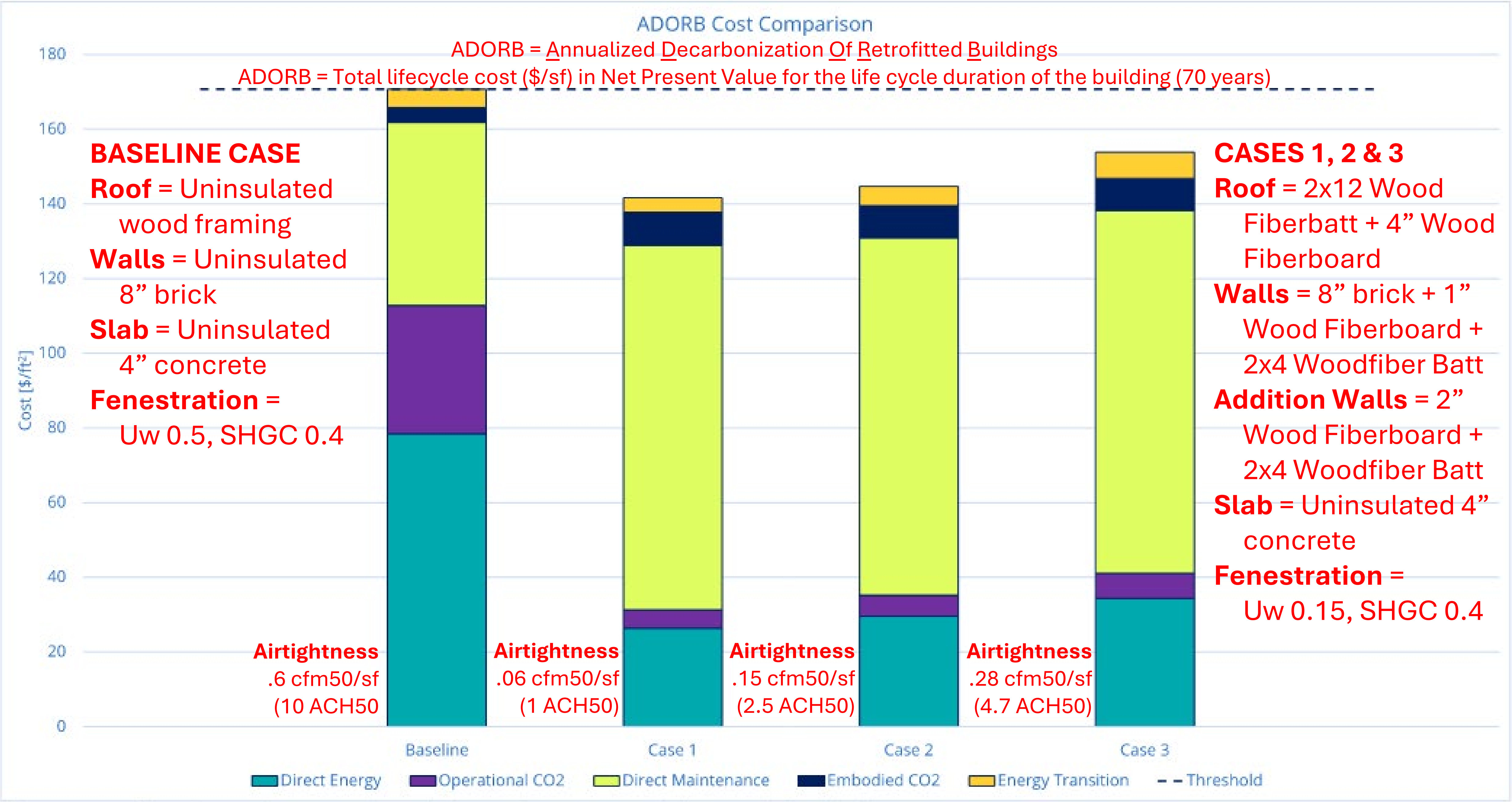
Air Tightness Reqmts
Phius =
.06cfm50/sf

Additional Insulation Req'd

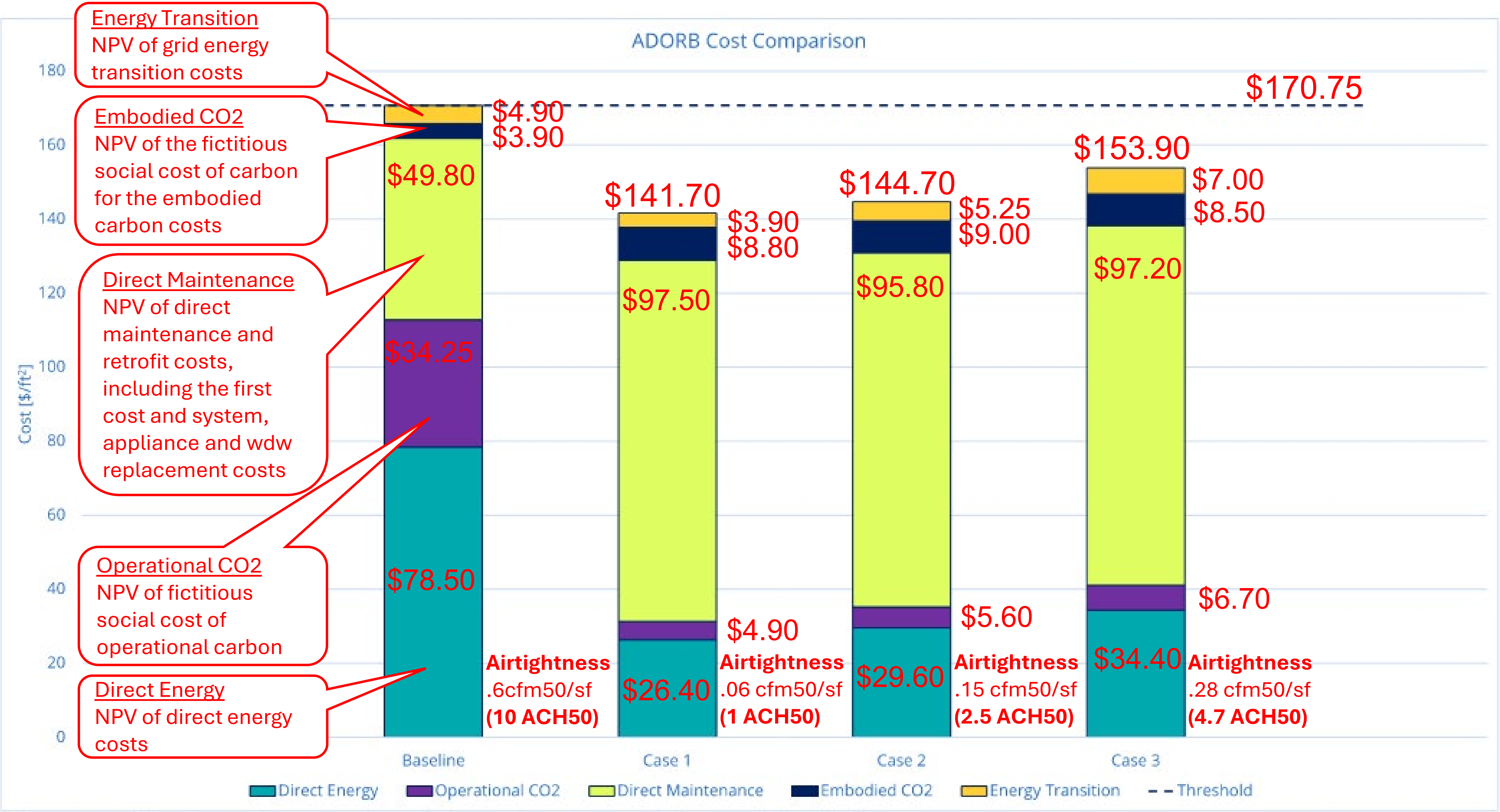


16% Reduction from 2021 IECC





*The ADORB cost of the Baseline case does not currently consider the cost of improvements to make the existing building habitable.



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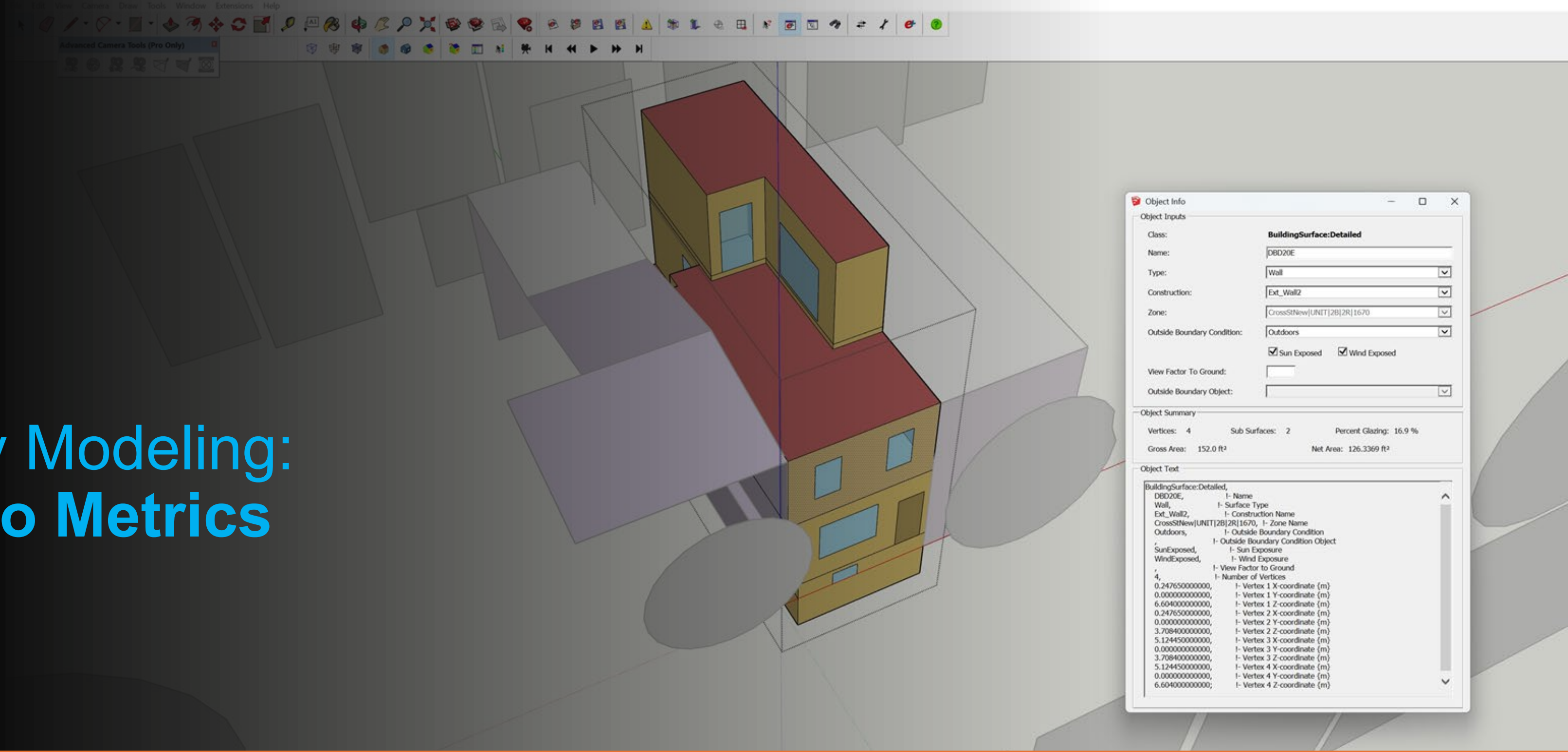
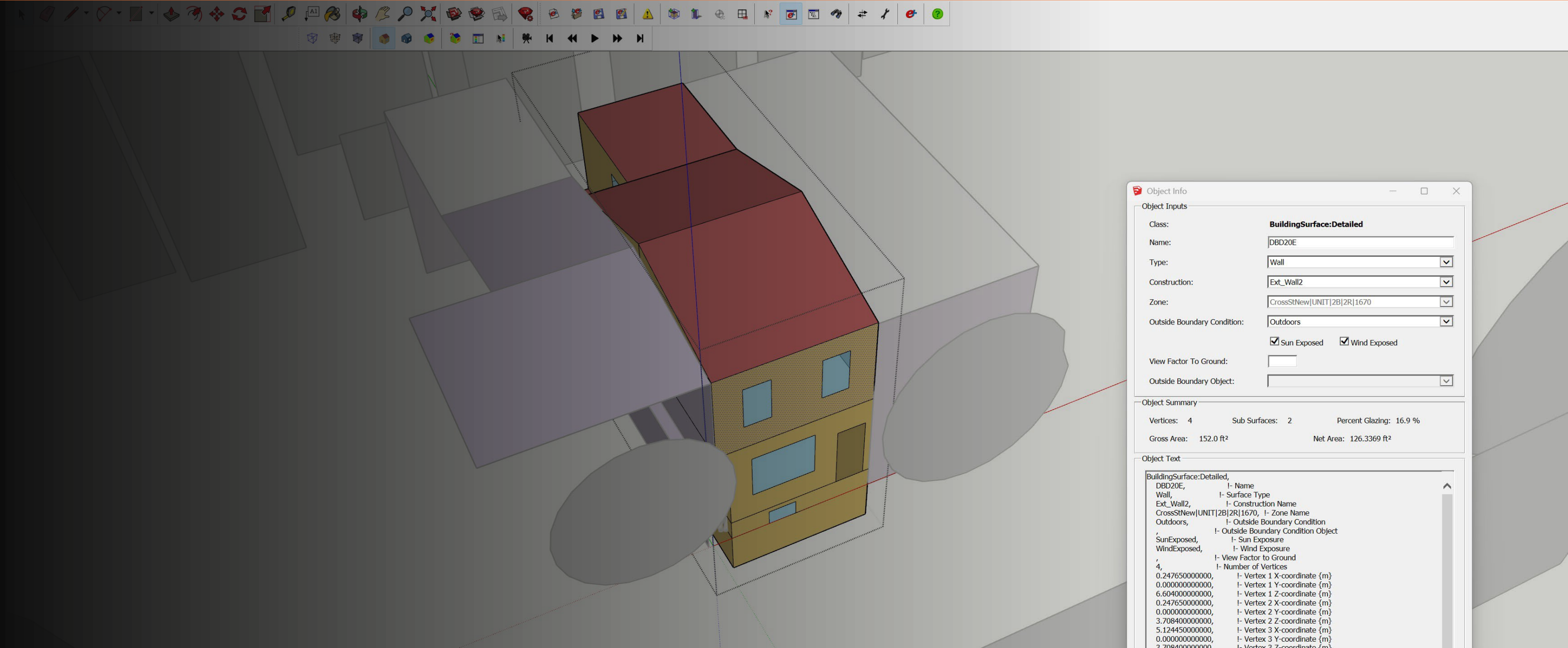
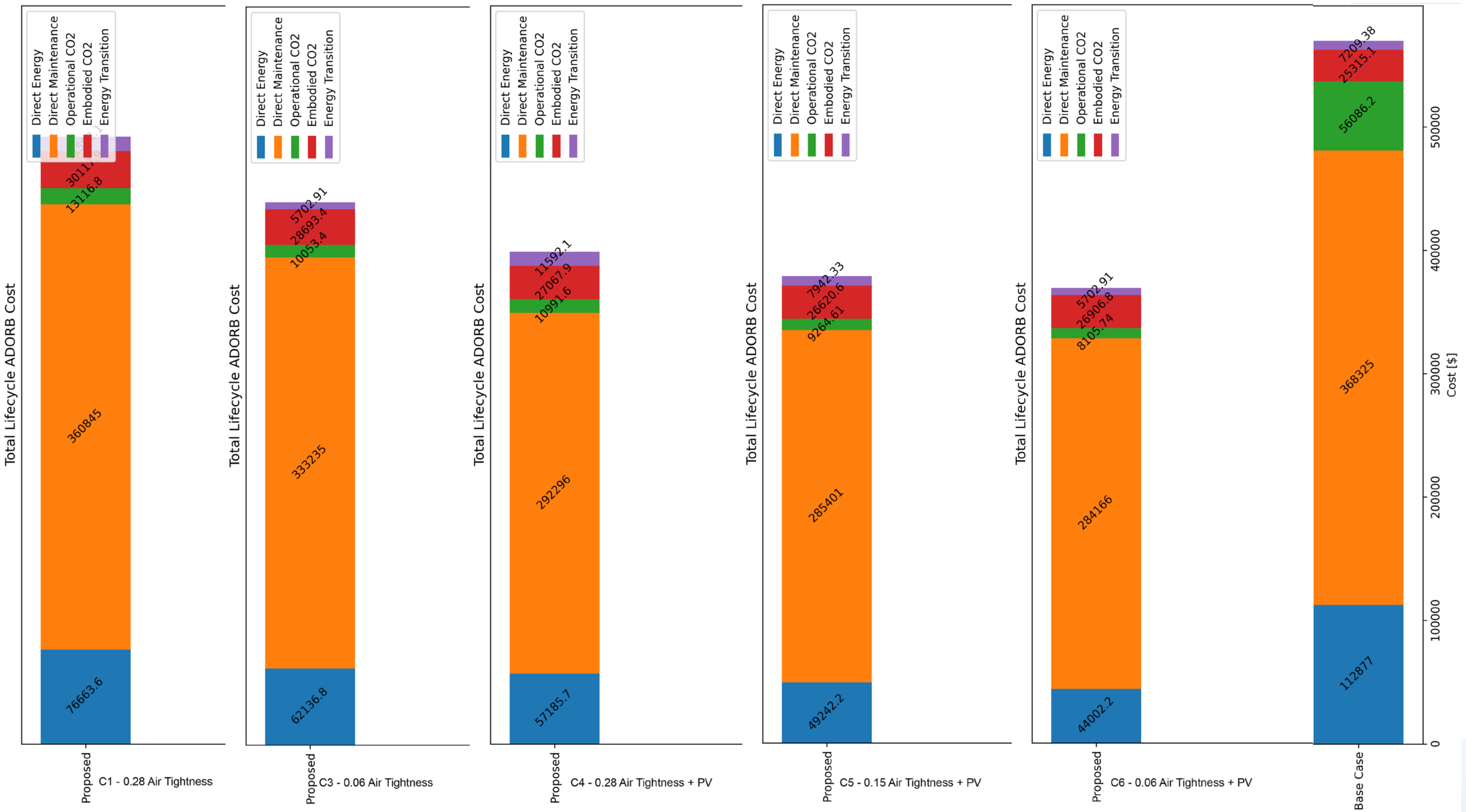
Phius REVIVECalc Energy Modeling:
Quantifying Big Ideas Into Metrics







Why does energy modeling matter?

We are working towards a comfortable indoor environment which uses less carbon over a long period of time as compared to if we did not retrofit the building.

How do we model energy?

The proposed retrofits use healthy, low-embodied carbon materials, and operate on electrified systems.

To understand if we as designers are doing this, we need to:

Enclosure:

Quantify how well the materials we use resist thermal heat transfer through conduction, radiation and convection. We look at materials' conductivity values and specific heat to understand the thermal movement in the building.

Building Systems:

Quantify heat and cooling systems' efficiencies, and the latent and sensible heat recovery of the energy recovery ventilator.

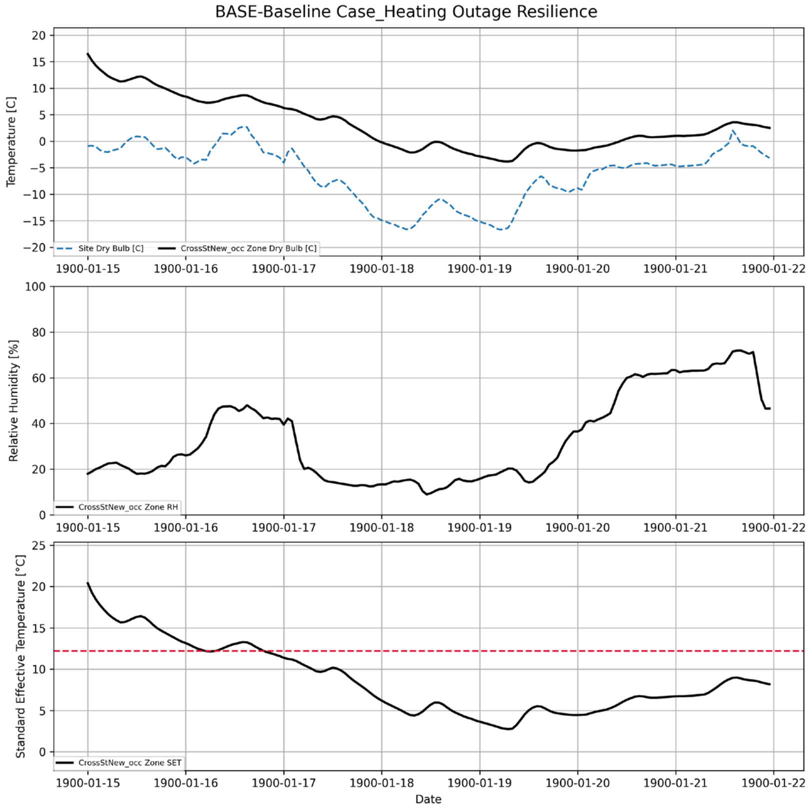
Loads:

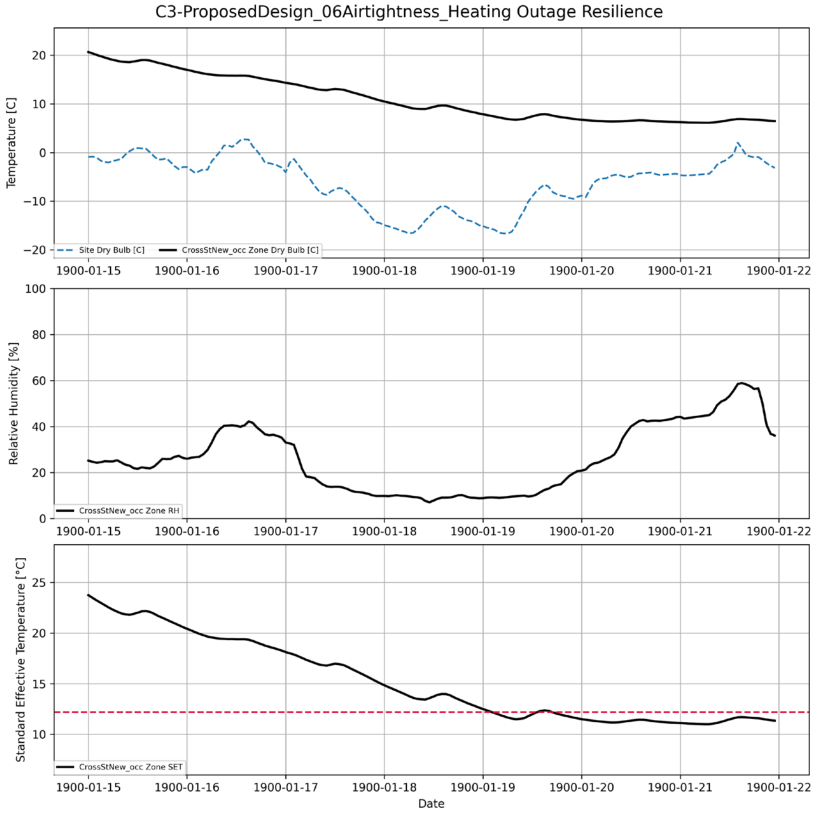
Input occupancy, lighting and plug loads and set temperatures. Much of this in REVIVECalc is handled with the EnergyPlus base file that PHIUS has created.

How is it interesting?

Admittedly, looking at numbers can be inaccessible.

The energy model enables us to tweak our inputs on materials, building systems and air tightness and see how this affects the EUI (kBtu / sf*year), carbon emissions, and resiliency.





What’s new about ReviveCalc?

Carbon Quantification of Materials and Operation Over Time:

REVIVECalc quantifies the amount of carbon a building will use over 70 years. As designers, we need to come up with a construction cost, which includes labor. Currently, the model is using this number to extrapolate carbon costs, although there is an additional input of CO2_per_area (kg/sm).

Energy Sources – Carbon Quantification:

The energy costs and supply are modeled, and the projected decarbonization of electricity is modeled over 70 years. This gives us an idea of how the building’s consumption of energy over 70 years (operational carbon) stacks against other options, and takes into account the decarbonization of the electrical grid.

Figure 1 – Direct GHG Emissions Factors for the U.S. and Canada

Fuel Type	CO_{2eq} Emissions		
	United States	Canada	
	(kg/MBtu)	(kg/MBtu)	(g/L)
Natural Gas	53.11		*By Province*
Propane	61.95	64.37	1,544
Fuel Oil (No. 1)	73.49	75.10	2,762
Fuel Oil (No. 2)	74.2	75.10	2,762
Fuel Oil (No. 4)	75.28	75.10	2,762
Fuel Oil (No. 5,6)	74.26	78.81	3,175
Diesel Oil	75.16	73.98	2,689
Kerosene	75.44	71.93	2,569
Coal (anthracite)	104.42	122.43	-
Coal (bituminous)	94.01	100.50	-
Coke	114.40	116.34	-

Dynamic Heat Load Calculation:

The calculation is a dynamic heat load calculation based on hourly data for a one year, captured in EPW or Energy Plus Weather data files and TMY files for Typical Meteorological Year based on location (NREL). (WUFI is a static calculation that considers average monthly temperatures.)

Extreme Weather Conditions and Resiliency, Survivability:

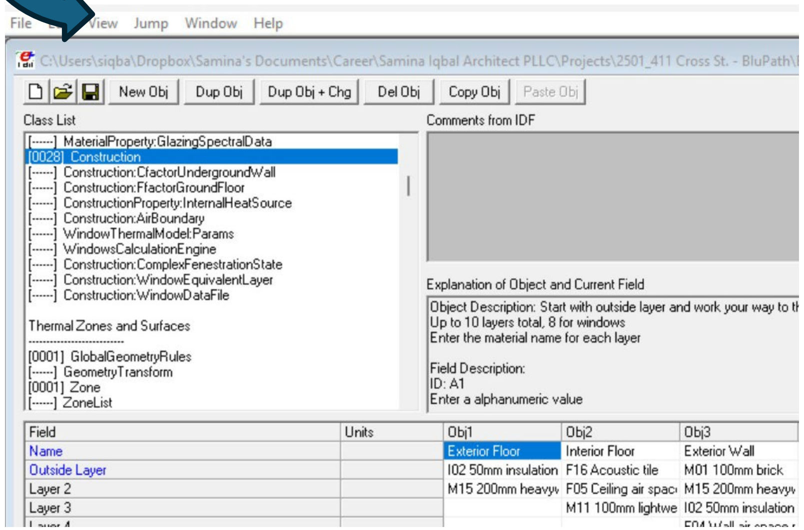
Weather data files are modified for extreme weather conditions. REVIVECalc considers the building performance during extreme conditions for one week in the summer and one week in the winter, and the building must be survivable.

Thermal Bridges:

Thermal bridges are added into one total value. Hygrothermal modeling is not part of the calculation.

How is REVIVECalc working?

Energy Plus IDF Editor.
Useful in debugging the geometry file.



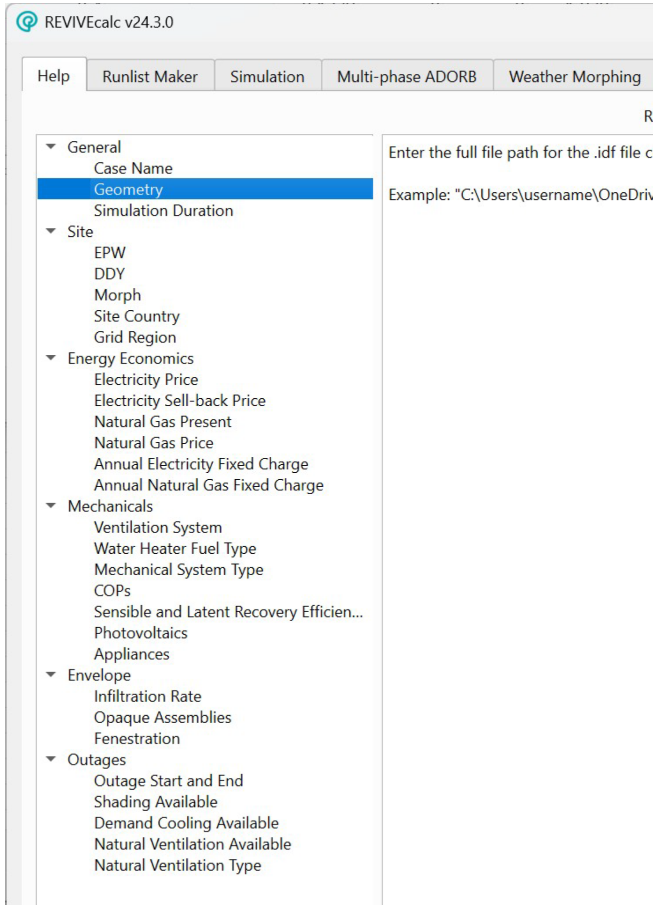
Uses EnergyPlus:

Phius REVIVE Standard uses the DOE EnergyPlus 9.5 software as the background engine for the heating and cooling load calculations.

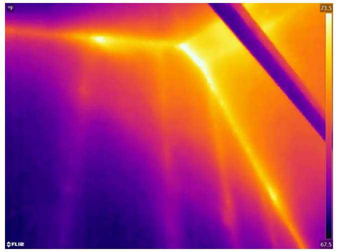
Phius REVIVECalc is a new software layer on top the EnergyPlus engine:

REVIVECalc is new software written by Phius in Python and uses the Energy Plus results while doing more calculations and providing an interface to build the cases and understand results.

The help videos are essential!
https://vimeo.com/user/129352609/folder/19374392?isPrivate=false



Takeaways for the Philly rowhome:



Airtightness is Crucial:

By making a tighter envelope, the resiliency, EUI and carbon costs are improved, and winter survivability is made possible.

Battery-Powered Demand Cooling is Required for Summer Survivability:

Relying only on natural ventilation is not enough to prevent deadly days, which must be 0.

Changes in Floor Area Must be Considered True Comparison:

Cost per unit of conditioned floor area - (based on GSF, this is \$368,883.20 / 1587 sf = 232.44 \$/sf for .06 air infiltration with PV, and \$569,812.67 / 1441 sf = 395.43 for the existing)

Winter Survivability – SET Hours must be less than 216

Summer Survivability – No Deadly Days permitted

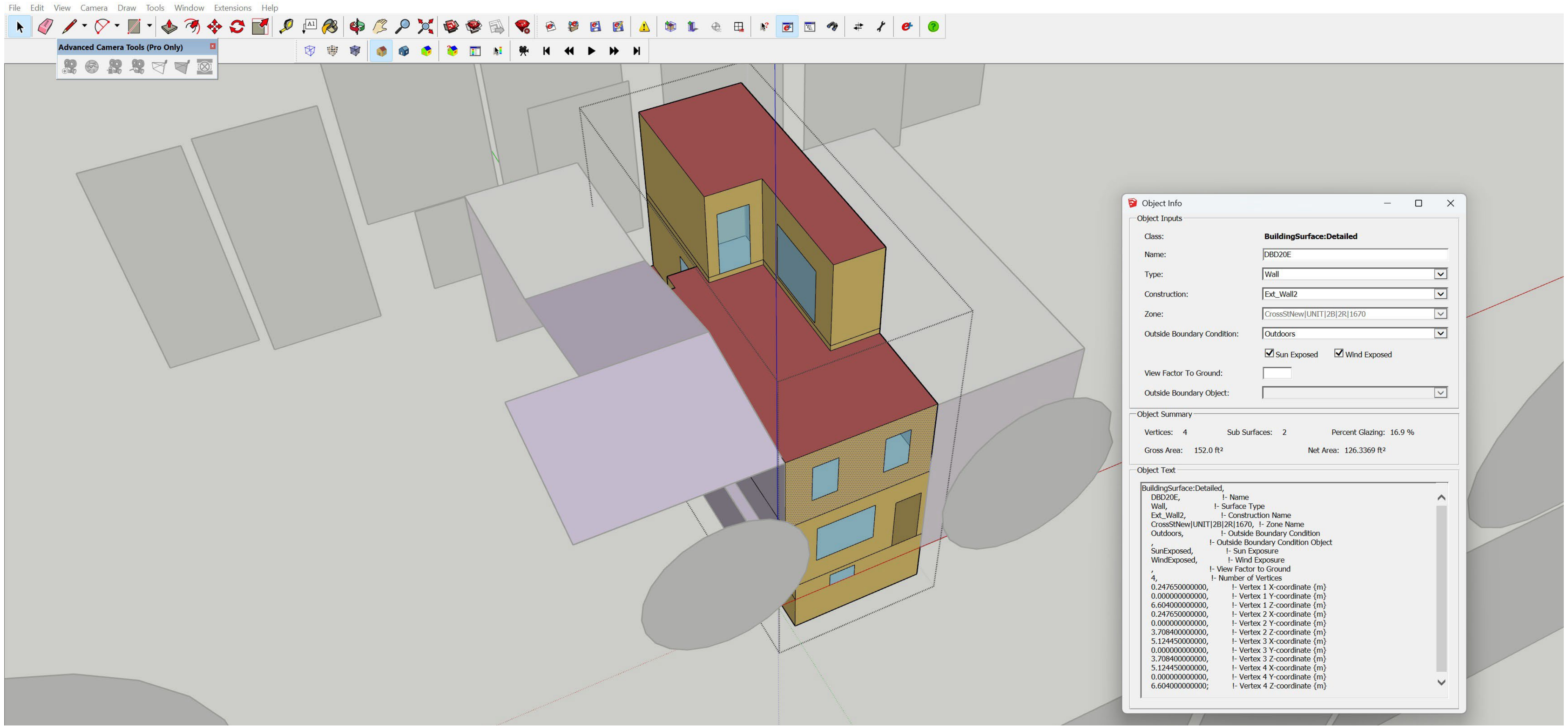
Result Review

Top Cases from Runlist:

	Case Name	SET hours	Deadly Days	EUI	First Cost	Total ADORB Cost
1	C6-ProposedDesign_06Airtightness_PV	49.66	0	16.74	110224.47	368883.20
2	C5-ProposedDesign_15Airtightness_PV	209.2	0	18.55	107827.11	378470.85
3	C3-ProposedDesign_06Airtightness	49.66	0	16.74	112904.63	439821.67
4	C2-ProposedDesign_15Airtightness	209.2	0	18.55	112117.67	458841.51
5	C4-ProposedDesign_28Airtightness_PV	404.33	0	21.2	109186.24	399133.38

REVIVECalc: Order of Operations

1. Model the geometry in Sketchup using the OpenStudio Plug-in.
    - Associate types to each component (Ext_Wall1, etc.). These types are parameters for the model. This parameterization allows for quick changes of the actual assembly types to be made in the Run List later, before simulation.

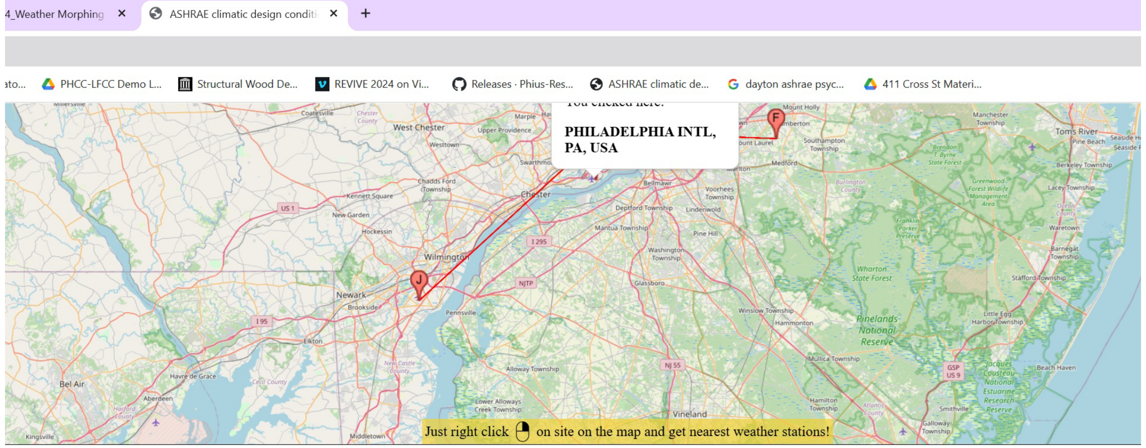


REVIVECalc: Order of Operations

1. Model the geometry in Sketchup using the OpenStudio Plug-in.

REVIVECalc: Order of Operations

2. Set up the weather data.
   - The Energy Plus Weather (EPW) file is a compilation of the most average months over 30 years. ReviveCalc takes into account the statistical extreme temperature weeks for summer and winter to check for resilience and survivability.
   - This is done in the Weather Morphing Tab, and then the EPW file is modified.



2021 ASHRAE Handbook - Foundamentals (SI)

PHILADELPHIA INTL, PA, USA (WMO: 724080)

Lat:**39.873N** Long:**75.227W** Elev:**3** StdP: **101.29** Time zone:**-5.00 (NAE)** Period:**94-19** WBAN:**13739** Climate zone:**4A**

Annual Heating, Humidification, and Ventilation Design Conditions

Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF
			99.6%			99%			0.4%		1%				
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
1	**-10.1**	**-7.9**	**-20.7**	**0.6**	**-8.4**	**-18.3**	**0.7**	**-6.2**	**12.8**	**1.1**	**11.8**	**1.5**	**5.6**	**290**	**0.509**

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%			
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD
7	**9.0**	**34.1**	**23.9**	**32.7**	**23.3**	**31.3**	**22.5**	**25.6**	**31.3**	**24.8**	**29.9**	**24.2**	**28.7**	**5.3**	**220**

Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Extreme Max WB
0.4%			1%			2%			0.4%		1%		2%		
DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB	
24.0	**18.9**	**28.1**	**23.3**	**18.1**	**27.3**	**22.7**	**17.4**	**26.8**	**78.5**	**31.4**	**75.2**	**29.8**	**72.5**	**28.9**	**30.2**

Extreme Annual Design Conditions

Extreme Annual WS				Extreme Annual Temperature				n-Year Return Period Values of Extreme Temperature							
				Mean		Standard deviation		n=5 years		n=10 years		n=20 years		n=50 years	
1%	2.5%	5%		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
11.1	**9.5**	**8.5**	DB	**-13.0**	**36.4**	**3.0**	**1.6**	**-15.1**	**37.5**	**-16.8**	**38.5**	**-18.5**	**39.4**	**-20.7**	**40.6**
			WB	**-14.3**	**27.0**	**2.7**	**1.2**	**-16.2**	**27.8**	**-17.8**	**28.5**	**-19.4**	**29.1**	**-21.4**	**30.0**

Monthly Climatic Design Conditions

		Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	DBAvg	**13.8**	**1.0**	**2.3**	**6.7**	**12.8**	**18.1**	**23.2**	**26.1**	**25.1**	**21.4**	**14.9**	**8.8**	**4.0**
	DBStd	**9.70**	**5.53**	**5.07**	**4.96**	**4.54**	**4.07**	**3.42**	**2.71**	**2.68**	**3.49**	**4.25**	**4.51**	**4.78**
Temperatures, Degree-Days and Degree-Hours	HDD10.0	**929**	**284**	**219**	**128**	**21**	**0**	**0**	**0**	**0**	**0**	**7**	**75**	**196**
	HDD18.3	**2450**	**538**	**448**	**363**	**174**	**56**	**4**	**0**	**0**	**12**	**123**	**287**	**446**
	CDD10.0	**2298**	**4**	**4**	**24**	**106**	**251**	**397**	**498**	**468**	**341**	**158**	**38**	**9**
	CDD18.3	**779**	**0**	**0**	**1**	**9**	**48**	**151**	**239**	**210**	**103**	**17**	**1**	**0**
	CDH23.3	**6787**	**0**	**0**	**8**	**98**	**423**	**1308**	**2360**	**1824**	**673**	**91**	**1**	**0**
	CDH26.7	**2484**	**0**	**0**	**1**	**27**	**131**	**473**	**989**	**664**	**186**	**14**	**0**	**0**

REVIVECalc: Order of Operations

3. Input materials using roughness, thickness (m), conductivity (W/mk), density (kg/m3), and specific heat capacity (J/kgK).
   - Be careful of units if using material specifications that have R values for total thicknesses!
   - Specific heat is often not published. Use ASHRAE tables, or Matweb.com.
   - Get a feel for the numbers! This will help you notice errors!

1		NAME	ROUGHNESS	THICKNESS [m]	CONDUCTIVITY [W/mK]	DENSITY [kg/m3]	SPECIFIC HEAT CAPACITY [J/kgK]
41	39	3in Wood Fiberboard	MediumRough	0.0762	0.0481	320	1880
42	40	0.5in gypsum board	MediumSmooth	0.0127	0.16	800	1090
43	41	FG 5.5in	MediumRough	0.1397	0.0438	64	960
44	42	0.625in gypsum board	MediumSmooth	0.0159	0.16	800	1090
45	43	FG 3.5in	MediumRough	0.089	0.0438	64	960
46	44	MWBoard 1.5 in	MediumRough	0.038	0.036	60	850
47	45	MWBatt 3.5in	MediumRough	0.089	0.04	60	850
48	46	4in Wood Fiberboard	MediumRough	0.102	0.0481	320	1880
49	47	11.25in Woodfibre batts	MediumRough	0.286	0.04	300	1500
50	48	XPS 3in	MediumSmooth	0.0762	0.0288	40	1500
51	49	2in Wood Fiberboard	MediumRough	0.0508	0.0481	320	1880
52	50	1in Wood Fiberboard	MediumRough	0.254	0.0481	320	1880
53	51	GreenFiber DP Cellulose 4in	MediumSmooth	0.1016	0.038978703	32.04	900
54	52	TimberHP TimberBatt 11.25in	MediumRough	0.28575	0.0360553	72.08325	2100
55	53	ACFoam II Polyiso 2in	MediumSmooth	0.0508	0.024444271	32.04	900
56	54	ACFoam II Polyiso 1/2 in	MediumSmooth	0.0127	0.024444271	32.04	900
57	54	ACFoam II Polyiso 4in	MediumSmooth	0.1016	0.024444271	32.04	900
58	54	TimberHP TimberBatt 7.25in	MediumRough	0.18415	0.0360553	72.08325	2100
59	55	Insultech R-Tech X EPS 15psi 3in	MediumSmooth	0.0762	0.020603029	21.624975	1300
60	56	Low-GWP CC SPF 7.25in	Rough	0.18415	0.021525552	32.037	920
61	57	Low-GWP CC SPF 2in	Rough	0.0508	0.021525552	32.037	920
62	58	Mineral Wool Panel 3in	MediumRough	0.0762	0.033539814	128	850

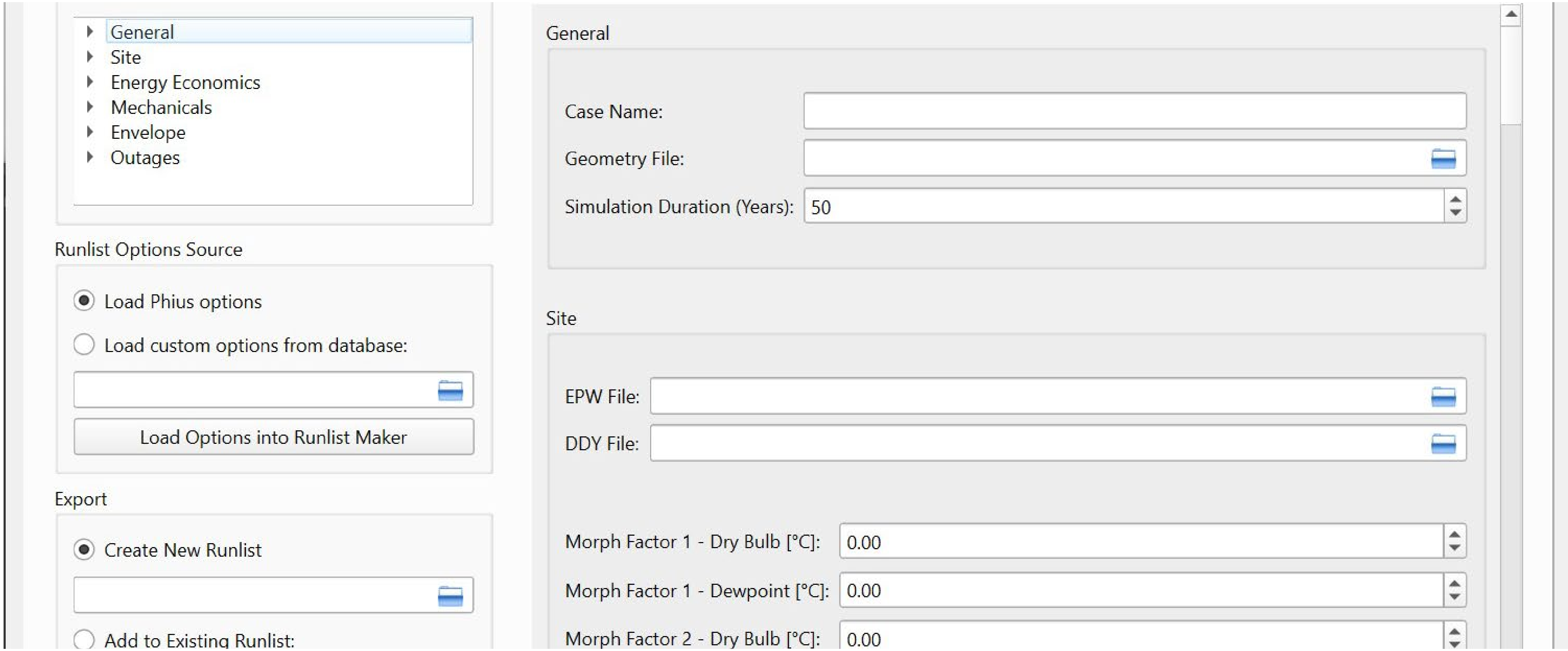
REVIVECalc: Order of Operations

4. ## Create construction assemblies referencing the materials.
   - Create descriptive names! Carefully reference material names!
   - Determine construction costs – contractor estimates, adding material costs, and https://remdb.nrel.gov
   - Lifetime of the assembly must be estimated. This will affect the Present Value Direct Maintenance Cost in the ADORB calculation.
   - Labor is included as a fraction of the total cost.

	Name	Type	CO2e_Per	Cost_Per_	Outside_L	Layer_2	Layer_3	Layer_4	Layer_5	Layer_6	Layer_7	Layer_8	Layer_9	Layer_10	Air_Sealing	Battery_C	PV_Cost_[	Mechanica	Appliance_	Lifetime	Labor_Fractio
69	CS_Ext_Roof2	Roof			Plywood (D	R-11 7.25 i	0.625in gypsum board													0	0.3
70	CS_Ext_floor1	Exterior Floor			M11 100mm lightweight concrete															0	0.3
71	CS_Ext_floor2	Exterior Floor			3in Wood F	0.5in gypsu	FG 3.5in	0.625in gypsum board												0	0.3
72	ExistingWindows	Window	205.2	100	ExistingWindows															0	0.5
73	AlpenFixed	Window	205.2		AlpenFixed															30	0.5
74	AlpenOperable	Window	205.2		AlpenOperable															30	0.5
75	CS_Ext_Door1	Exterior Dc	66.6	250	G05 25mm wood															30	0.3
76	CS_Ext_wall5.1	Exterior Wall			8in Old bri	MWBoard	0.625in gypsum board													0	0.3
77	WINDOW_U-0.5 g=0.4	Window	205.2	100	U-0.5 g=0.4															30	0.5
78	WINDOW_U-0.4 g=0.4	Window	205.2	139.94	U-0.4 g=0.4															30	0.5
79	WINDOW_U-0.3 g=0.4	Window	205.2	258.34	U-0.3 g=0.4															30	0.5
80	WINDOW_U-0.2 g=0.4	Window	228.6	357.63	U-0.2 g=0.4															30	0.5
81	WINDOW_U-0.1 g=0.4	Window	228.6	603.36	U-0.1 g=0.4															30	0.5
82	WINDOW_U-0.5 g=0.2	Window	205.2	100	U-0.5 g=0.2															30	0.5
83	WINDOW_U-0.4 g=0.2	Window	205.2	139.94	U-0.4 g=0.2															30	0.5
84	WINDOW_U-0.3 g=0.2	Window	205.2	258.34	U-0.3 g=0.2															30	0.5
85	WINDOW_U-0.2 g=0.2	Window	228.6	357.63	U-0.2 g=0.2															30	0.5
86	WINDOW_U-0.1 g=0.2	Window	228.6	603.36	U-0.1 g=0.2															30	0.5
87	WINDOW_U-1.0 g=0.5	Window	180	100	U-1.0 g=0.5															30	0.5
88	WINDOW_U-0.15 g=0.4	Window	228.6	420	U-0.15 g=0.4															30	0.5
89	WINDOW_U-0.15 g=0.2	Window	228.6	420	U-0.15 g=0.2															30	0.5
90	CS_Ext_Roof_R.1	Roof	276.2	60	Plywood (D	4in Wood F	Plywood (D	TimberHP	0.5in gypsum board											70	0.5
91	CS_Ext_Roof_R.2	Roof	142.08	60	Plywood (D	4in Wood F	Plywood (D	TimberHP	0.5in gypsum board											70	0.5
92	CS_Ext_Roof_RX.1	Roof	241.32	60	Plywood (D	TimberHP	Low-GWP	0.5in gypsum board												70	0.5
93	CS_Ext_Wall_W.1	Exterior W.	154.56	60	HardiePlar	F04 Wall a	3in Wood F	Plywood (D	TimberHP	0.625in gypsum board										70	0.5
94	CS_Ext_Wall_W.1A	Exterior W.	63	60	HardiePlar	F04 Wall a	3in Wood F	Plywood (D	TimberHP	0.625in gypsum board										70	0.5

REVIVECalc: Order of Operations

5. **Create the simulation cases in the Run List.**
   - Mechanical system information, PV information, and energy source is input here.
   - Construction assemblies are associated to model parameters here. They can be different for every case.



REVIVECalc: Order of Operations

5. The Run List is also an csv file!

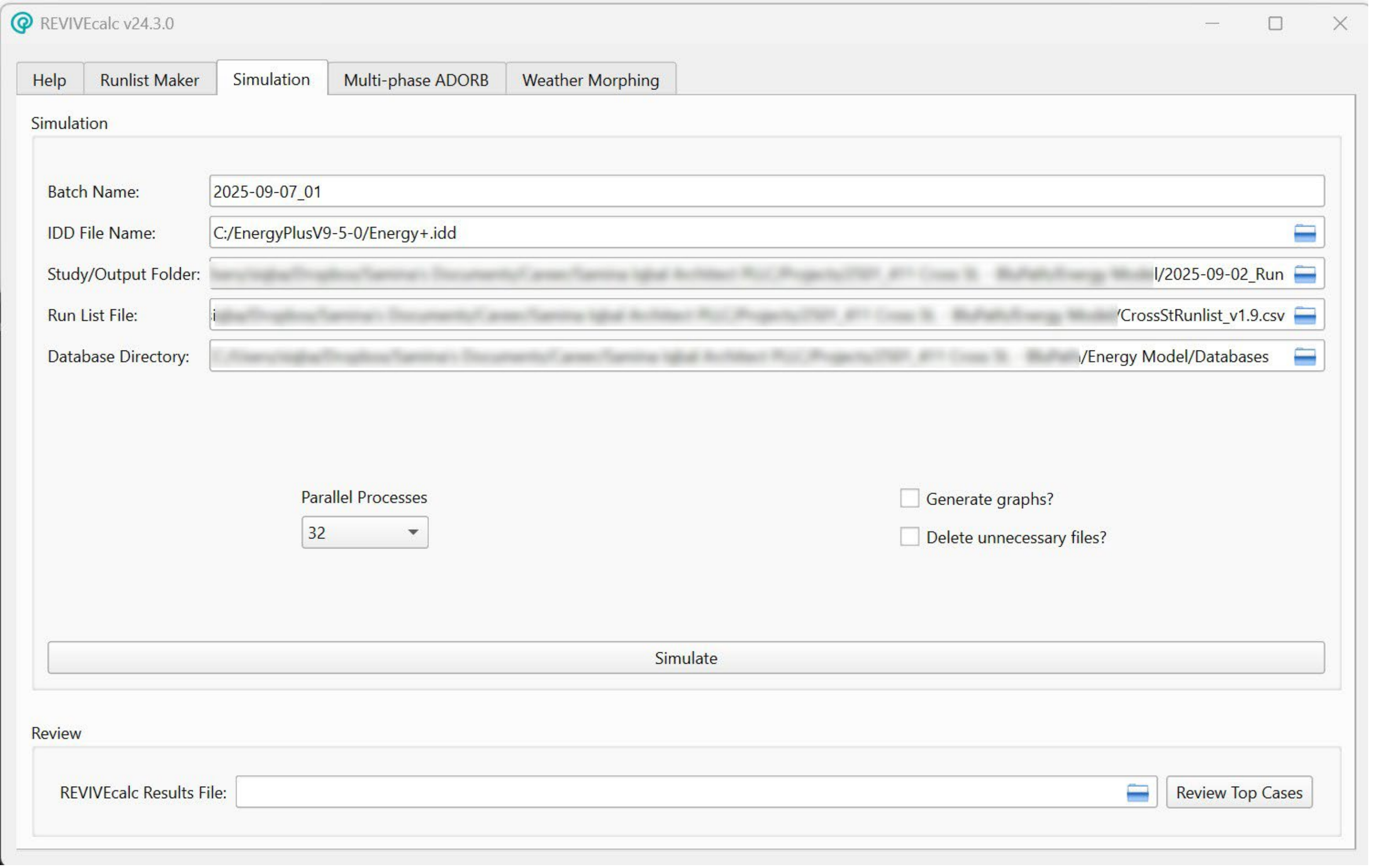
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
CASE_NAI	GEOMETR	ANALYSIS_	EPW	DDY	MorphFact	MorphFact	MorphFact	MorphFact	ENVELOPE	GRID_REG	ENVELOPE	PERF_CAR	NON_PERI	ELEC_PRIC	SELLBACK	NATURAL_	GAS_PRICI	ANNUAL_(	ANNUAL_E	MECH_SYS	WATER_HE	VENT_SYS	HEATING_(	COOLING_	SENSIBLE_	LATENT_RI	PV_SIZE_[V	PV_TILT	PV_AZIMU	APPLIANC	INFILTRATI	CHI_VALU	Operable_	Operable_	Operable_	Operab
BASE-Base	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	1	1.373	0	200	GasFurnac	NaturalGa	Exhaust	0.7	3	0	0	1	0	0	FRIDGE 36	0.6	0	48	0	39	
C1-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	1	0	0	FRIDGE 36	0.22	0	85	0	92	
C2-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	1	0	0	FRIDGE 36	0.15	0	85	0	92	
C3-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	1	0	0	FRIDGE 36	0.06	0	85	0	92	
C4-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	3300	30	180	FRIDGE 36	0.22	0	85	0	92	
C5-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	3300	30	180	FRIDGE 36	0.15	0	85	0	92	
C6-Propos	C:/Users/s	70	C:/Users/s	C:/Users/s	-3.53	1.79	8.48	2.32	USA	RFCEc	0.4			0.1779	0	0	1.373	0	200	PTHP	Electricity	Balanced	3.1	4	0.8	0.7	3300	30	180	FRIDGE 36	0.06	0	85	0	92	

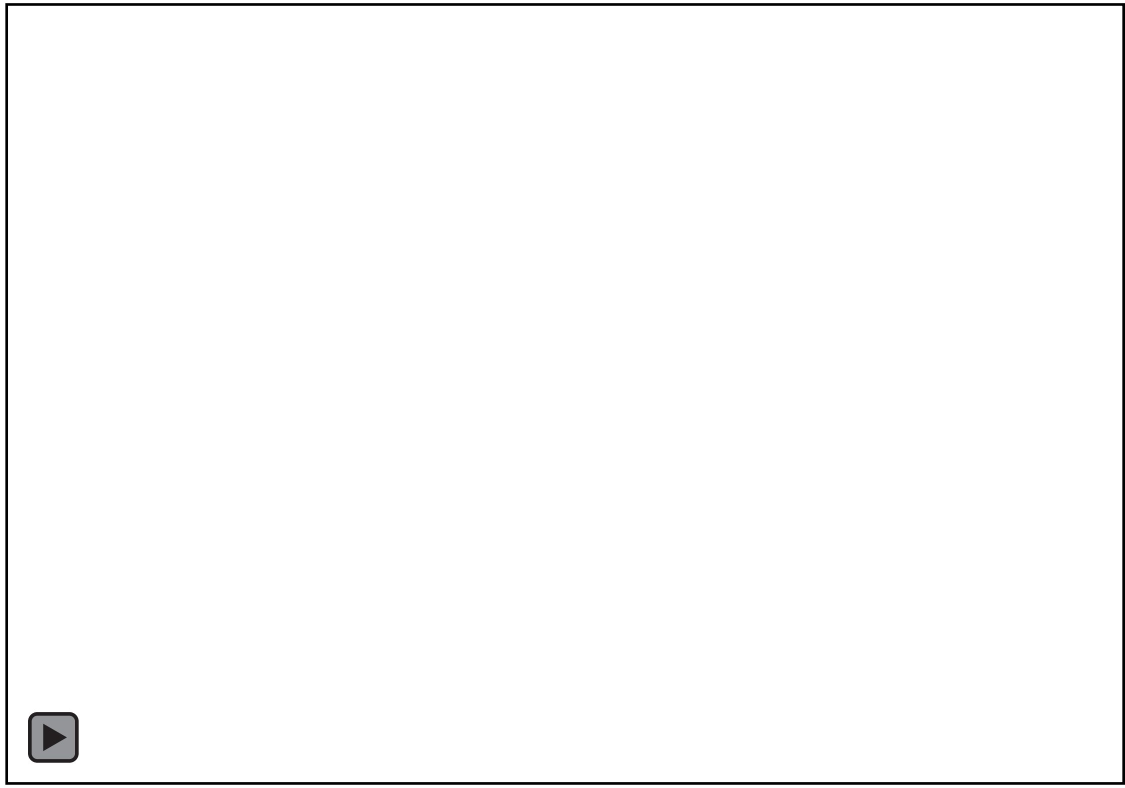
Wall types changed for the base case and the proposed cases

AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK		BM	BN	BO	BP	BQ	BR	
Operable_	FOUNDAT	FOUNDAT	FOUNDAT	FOUNDAT	EXT_WIND	EXT_WALL	EXT_ROOF	EXT_FLOO	EXT_DOOF	INT_FLOOI	FOUNDAT	FOUNDAT	FOUNDAT	FOUNDAT	EXT_WIND	EXT_WALL	EXT_ROOF	EXT_FLOO	EXT_DOOF	INT_FLOOI	FOUNDAT	FOUNDAT	FOUNDAT	FOUNDAT	EXT_WIND	EXT_WALL	EXT_ROOF	EXT_FLOO	EXT_DOOF	INT_FLOOI	1ST_OUTA	OUTAGE_1	OUTAGE_1	OU
8	Basement	0.5in gypsu	0	0.01	WINDOW_	CS_Ext_wa	CS_Ext_Ro	CS_Ext_flo	CS_Ext_Dc	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_wall6		CS_Ext_flo	Exterior Door						WINDOW_	CS_Ext_wall6					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	
8	Basement	0.5in gypsu	72	0.01	WINDOW_	CS_Ext_Wa	CS_Ext_Ro	CS_Ext_Flo	AlpenDoor	CS_Int_Floor_FLX.1					WINDOW_	CS_Ext_Wall_W.2		CS_Ext_Flo	AlpenDoor_HeritageGlass						WINDOW_	CS_Ext_Wall_W.3					HEATING	14-Jan	21-Jan	

REVIVECalc: Order of Operations

6. Run the using the simulation tab in REVIVECalc.
   - This is where all the parts and pieces are assembled!
   - Be ready for errors. But celebrate when you work through them all and it runs!





GREEN BUILDING UNITED

Passive House + Living Future Communities

Phius REVIVE / Living Future Core

Demonstration Learning Series

https://greenbuildingunited.org/news/alignment-through-the-language-of-carbon-a-crosswalk-exploration-of-phius-revive-and-living-future-core/

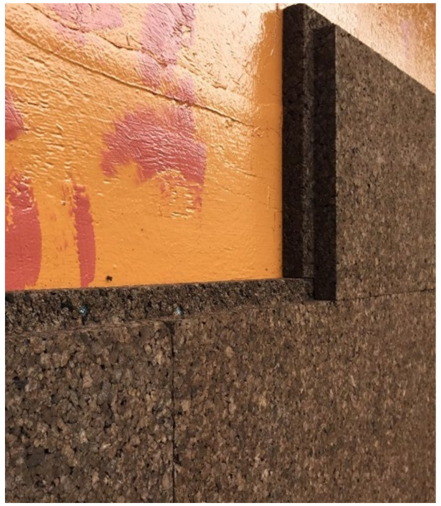
** Wood Fiber **

Wool

Fiberglass

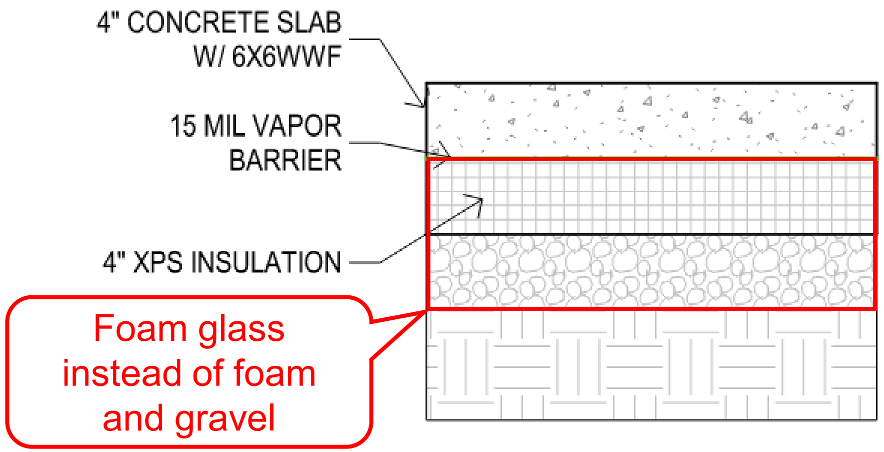
Mineral Wool

** Cellulose **

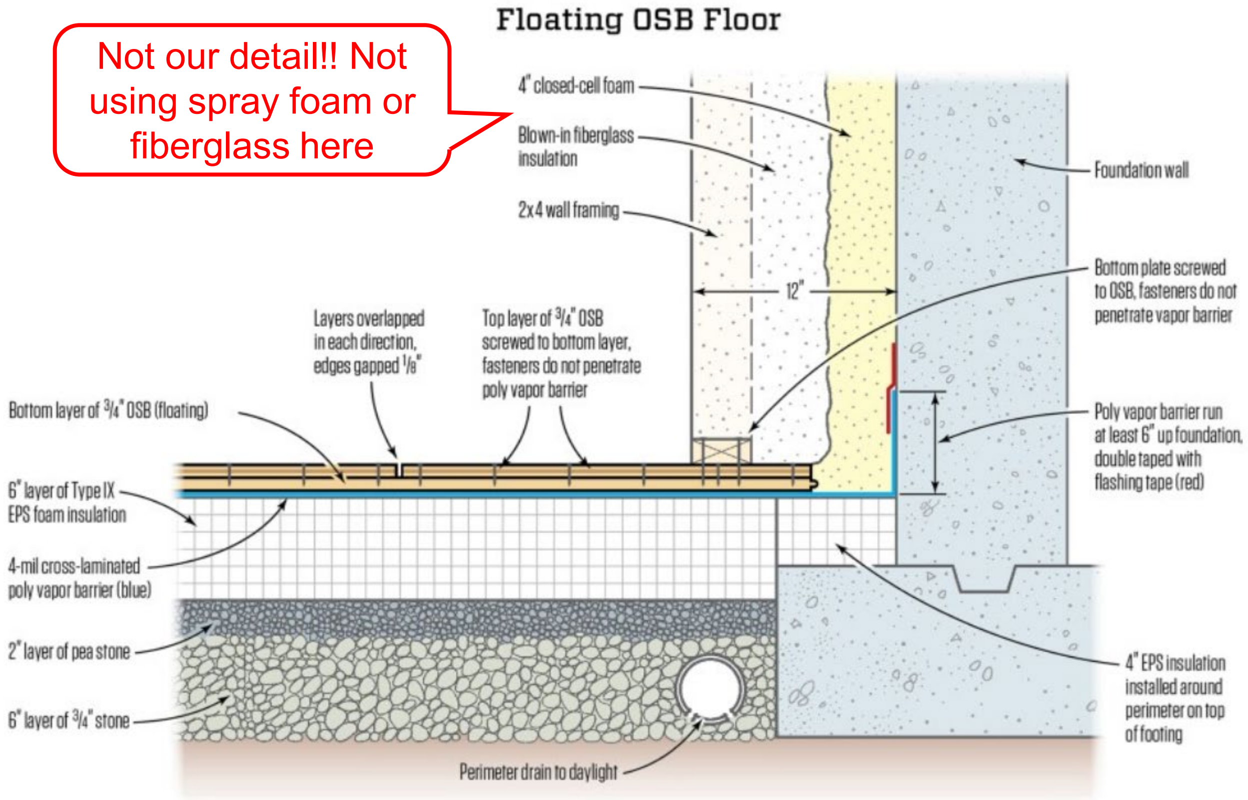


** Cork **

**** AGRI-BASED INSULATION****



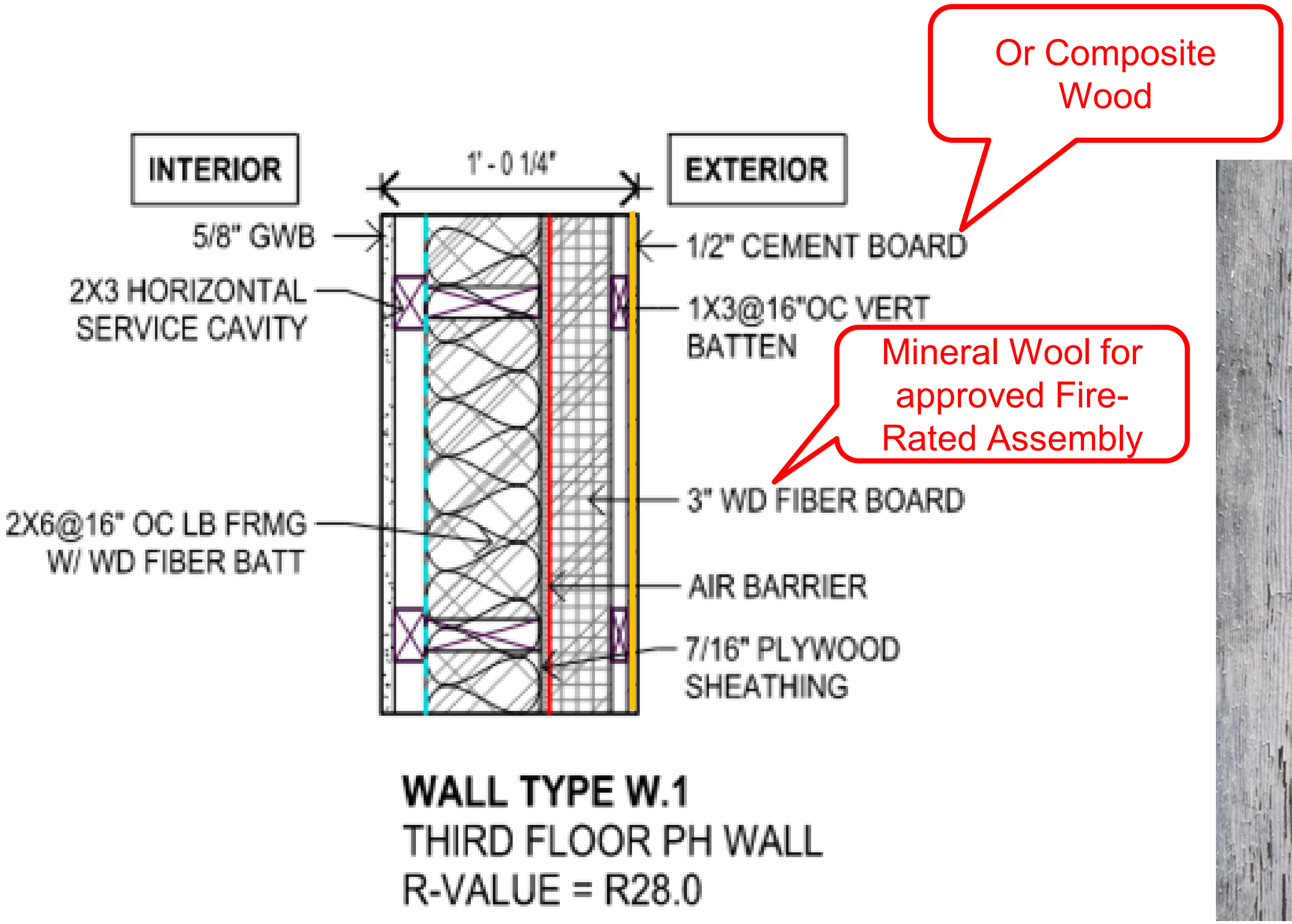
FLOOR TYPE SL.1
INSULATED BASEMENT SLAB



Basement Slab
Replaces Uninsulated Slab = 529sf

Basement Wood Slab
Replaces 529sf Concrete

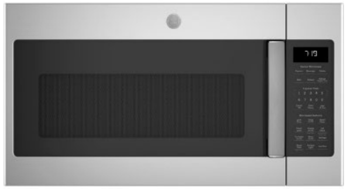
INSULATED WOOD INSTEAD OF CONCRETE SLAB??



Wood Wall Framing
Vented Rainscreen at Addition = 386sf
1 hr Fire Separation at Prop Line = 313sf

Wood Wall Framing
Unvented Cork Facade at Addition = 386sf
Class B Fire Separation at Prop Line = 313sf

CORK INSTEAD OF CEMENT BOARD ??



MW.1
GE JVM7195SK

RANGE.1ALT
GE PHS93EYPFS

DW.1
GE GDT650SYV_SMV

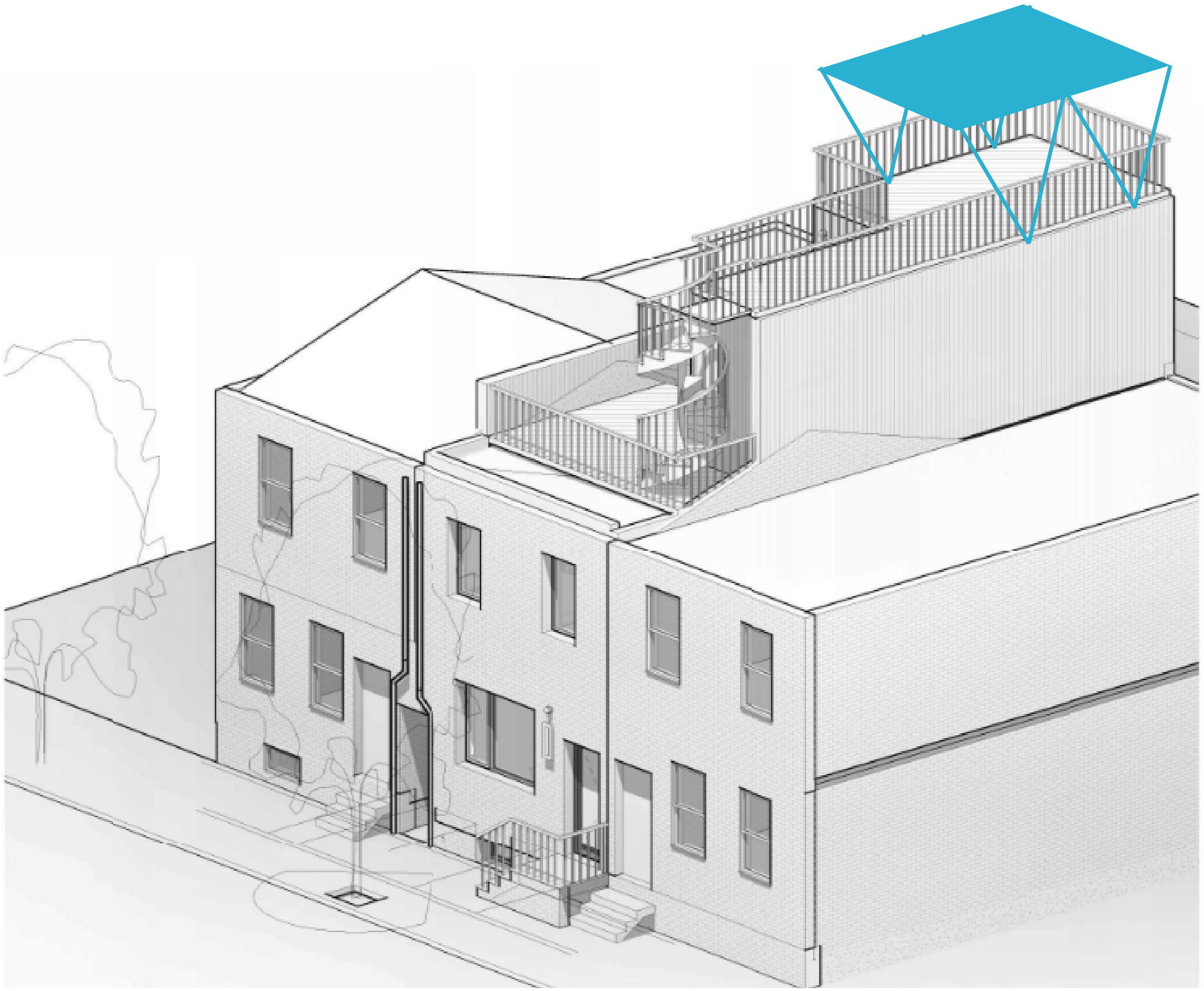
FRZ.1
Samsung RZ11M7074SA

RANGE.1
GE PB965YP_BP

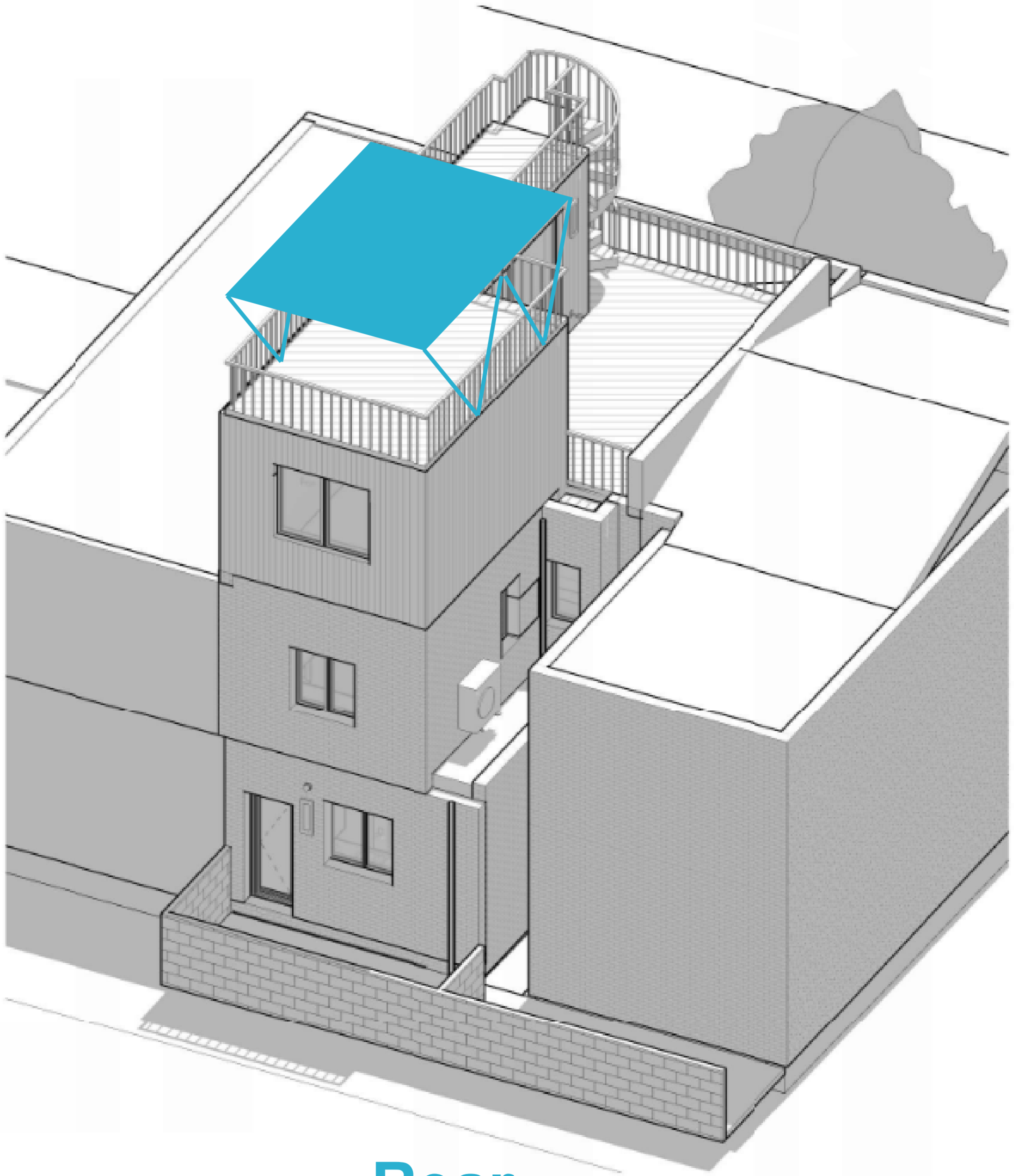
WD.1
GE PFQ97HSPVDS

REF.1
GE GFE28GBL

=



Front



Rear

SOLAR CANOPY DESIGN

SOLAR STATES

6 Modules

545 Watts - transparent backsheet

Brooklyn Solar Canopy

$25k-$30k - Total Cost

30% ITC tax credit

~3600 kWh/year in utility energy avoided

~$650/year in utility bill savings

~$126/year in PA SRECs

SOLAR CANOPY DESIGN

ENERGY BUDGET from CRITICAL LOADS

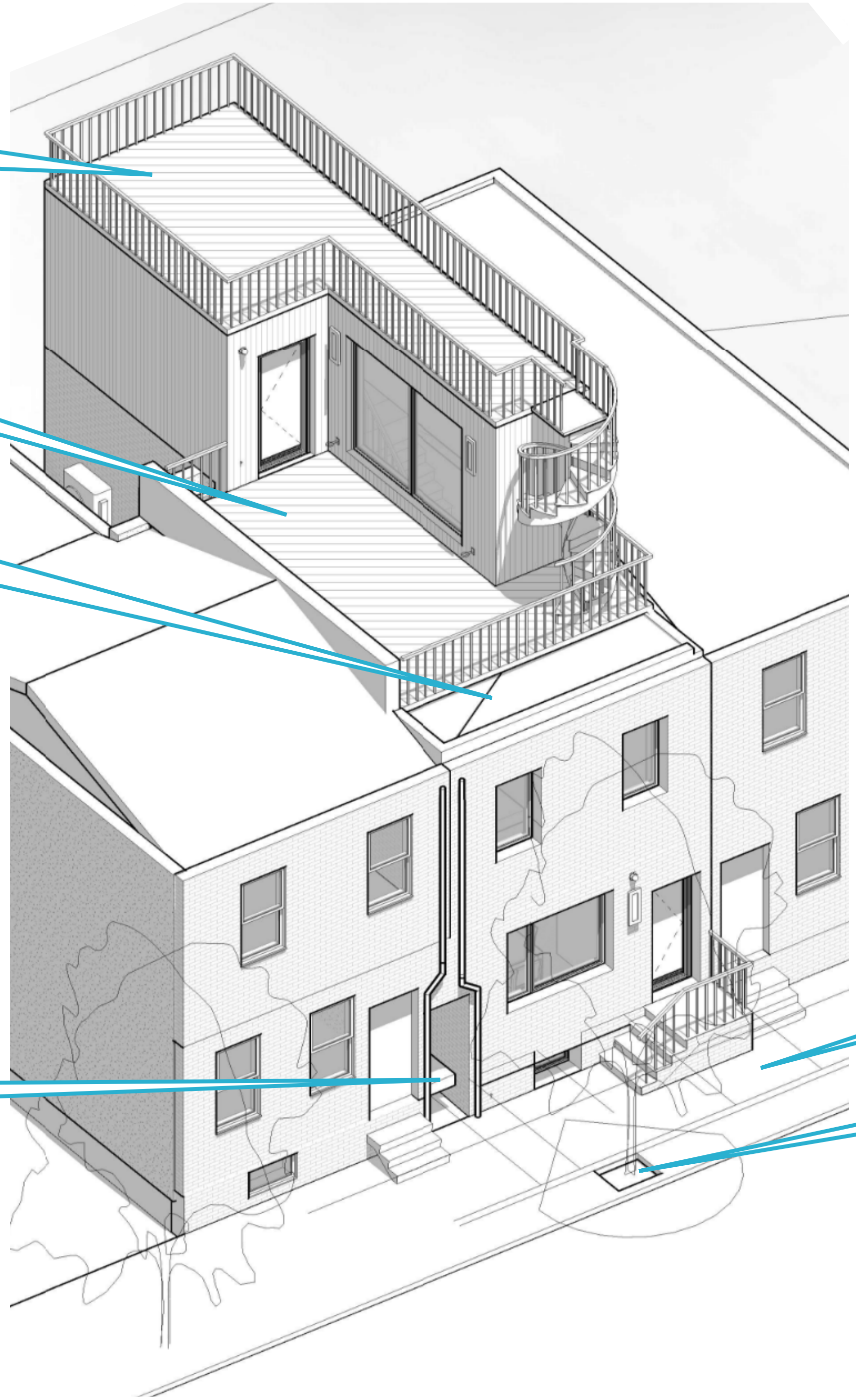
Estimated Daily Consumption	56 kWh
Estimated Daily Solar Production	
Summer	14 kWh
Winter	4 kWh
Need from Battery	
Summer	42 kWh
Winter	52 kWh
Total Batteries	2-3 units

Battery Cost ($11k each) = $22k - $33k

How can this project contribute to 'Community Resilience'?

'SMART' ELECTRIC PANEL WITH BATTERY BACKUP

FEMA's National Flood Hazard Layer (NFHL) Viewer with Web AppBuilder for ArcGIS



SURFACE AREAS

UPPER DECK	= 262 SF
LOWER DECK	= 237 SF
FRONT ROOF	= 80 SF
REAR ROOF	= 9SF
LOWER ROOF	= 29 SF
ALLEY	= 48 SF
REAR YARD	= 111 SF
LOT SIZE	**= 776 SF**
SIDEWALK	= 144 SF
TREE PIT	= 9 SF

DAILY WATER USE ESTIMATOR

Use	Number per Day	Number of Minutes	Gallons per Minute	Gallons per Use	Gallons per Day
Bath	0.5			36	18
Shower	1	10	1		10
Teeth Brushing	2			1	2
Hand Washing	10	1	1		10
Dishwasher	0.5			6	3
Hand Dishwashing	1	5		9	9
Laundry	0.25			25	6.25
Drinking Potable per Glass (8 oz)	8			0.06	0.48
Toilets (could be non-potable)	10			1.6	16
TOTAL WATER NEED					**74.73**
Percent reduction if toilets use non-potable					21.41%

RAINFALL CALCULATOR

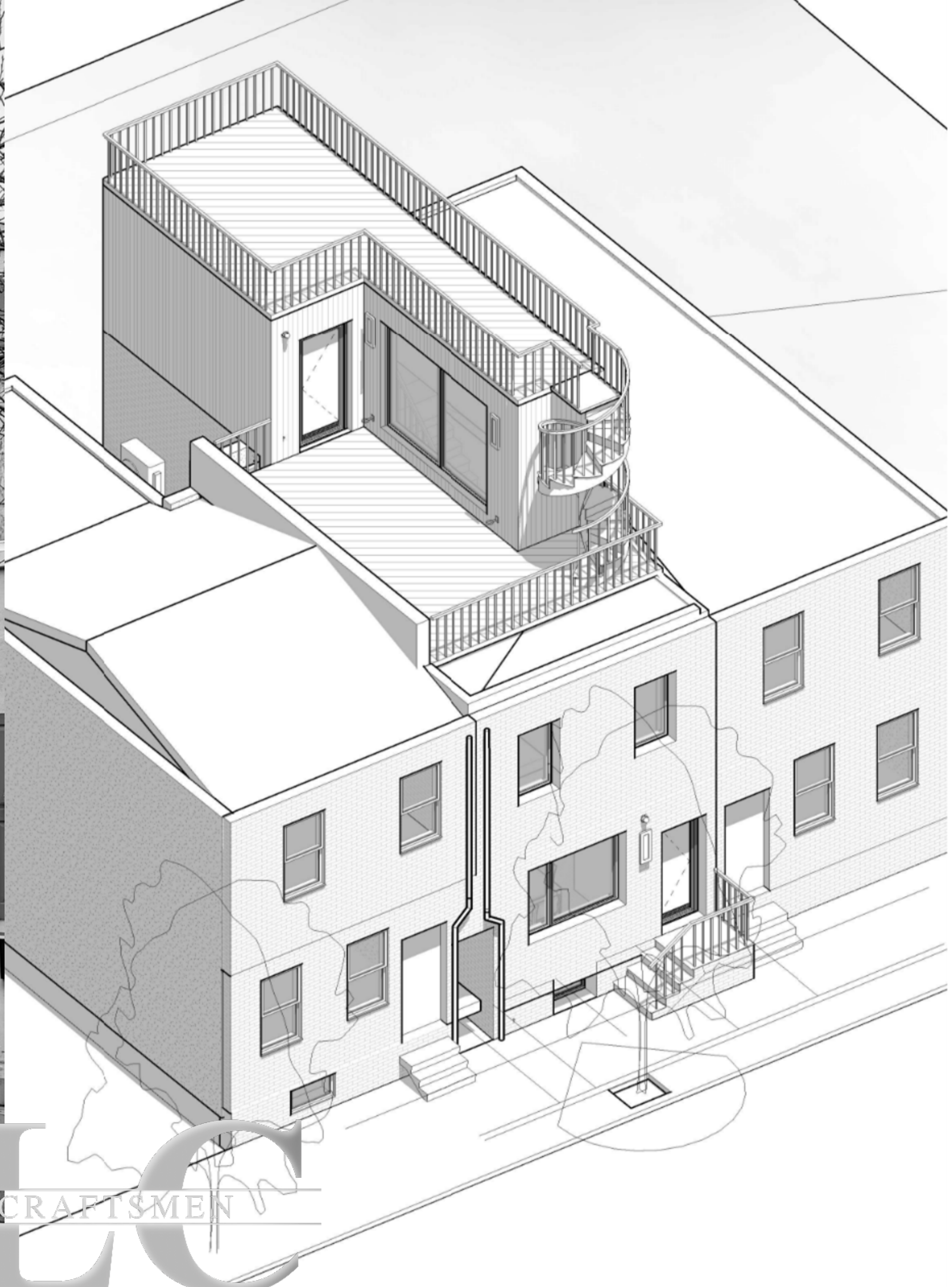
Roof Area	**Rainfall Depth**	
614 sf	3 in	**1148 gallons**
Site Area	**Rainfall Depth**	
806 sf	3 in	**1507 gallons**

PRE-DESIGN WATER USE ESTIMATOR

STRATEGIES

- Store and slowly release
- Store and reuse
  - Internal
  - External
- Infiltrate
- Green or Purple roof
- Tree trench
  - Right-of-way belongs to City
  - Utility conflicts

GREEN INFRASTRUCTURE



MLC
MAIN LINE CRAFTSMEN

Preliminary Cost

$765,000 / 2,222sf = $344/sf

Thank You -
Paul, Laura, and Samina

BLUPATH

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SAMINA IQBAL ARCHITECT

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