

Lincoln School Apartments NYSERDA Early Design Support



Fig: North Elevation
Drawing by Sanders Architects

Owner:
S.T.E.P. by S.T.E.P., Inc.
1515 Knox St, Ogdensburg,
New York, 13669

Prepared by:
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Lincoln School Apartments

Executive Summary

To support the development team's goals and the State of New York's climate commitments, the Lincoln School Apartment project consists of the new construction of a 3-story, 42 unit building on the site of the Lincoln School in Ogdensburg, NY. Owned and operated by S.T.E.P. by S.T.E.P Inc, the \$8.993 Million construction project is funded through the NY Homeless Housing Assistance Program [HHAP] and received \$750,000 through the Federal Home Loan Bank program, boosted by a commitment to achieve Passive House [Phius] Certification.

In partnership with the NYSERDA Buildings of Excellence [BOE] Early Stage Program, this report is intended to show how Sustainable Comfort was able to work with the team from early design concepts to develop a pathway to Passive House certification in the coldest region of the state in Climate Zone 6. The BOE early design funding allowed the team to review the following features into the design:

- Clean and Carbon Neutral Attributes: Passive House Feasibility and WUFI energy modeling to optimize design.
- Resiliency and Passive Survivability: Explore Passive House implications in NY Climate Zone 6.
- Non-Energy Co-Benefits: Include EPA Indoor AirPLUS features into the design.
- Third Party Certification: Achieve Phius 2021 Design Certification, Energy Star Multifamily, DOE Zero Energy Ready, and EPA Indoor AirPLUS.

This report outlines the initial concepts and feasibility study for Phius Certification, along with specific design details, insulation levels, and mechanical systems that were adjusted to achieve a Phius Design Certification. This report is geared toward early-stage schematic design level projects interested in understanding what level of insulation and mechanical systems to include in Climate Zone 6 for similar building types. This report will also allow Sustainable Comfort to provide customized feedback for other projects located in these colder regions of New York interested in Passive House, and what benefits it can provide. Pricing and data reflect research and design that occurred in 2024.



Lincoln School Apartments

Project Description

The Lincoln School Apartments builds on the success of the original school renovation project opened in 2022 in Ogdensburg, NY [Climate Zone 6]. It is owned and operated by S.T.E.P by S.T.E.P., Inc. The Lincoln School site currently provides 20 units of permanent support housing at the former elementary school for adults with mental illness who experienced homelessness. The New Construction project located on the site will provide an additional 42 units with 40 studio apartments and two 1-Bedroom apartments in a 28,167 square foot 3-story building. The \$8.993 Million project is funded through the Homeless Housing and Assistance Program [HHAP] with \$750,000 funding through the Federal Home Loan Bank.

To receive the \$750,000 from the Federal Home Loan Bank the project was awarded 5 points in the Green Building Innovation Category which was critical to set the project apart and receive the additional funding. For HHAP funding the project also required energy efficiency including committing to Energy Star Multifamily New Construction and all-electric low carbon building design to meet the NY Climate Leadership and Community Protection Act [CLCPA].



Lincoln School Rendering [Drawings by Sanders Architects]



Lincoln School Apartments

NYSERDA Early-Stage Design Support

The New York State Energy Research and Development Authority (NYSERDA) Buildings of Excellence (BOE) initiative is aimed to help achieve the State's housing goal of creating 2 million climate-friendly homes. The BOE program offers two distinctive Request for Proposal (RFP) opportunities, the Demonstration and Early Design Support programs. These programs foster the growth and development of replicable, clean, resilient, and carbon-neutral multifamily buildings that prioritize occupant health and safety while maintaining predictable costs. BOE offers funding for both early exploration and late design phases to comprehensively support projects in both soft and hard cost investments.

The Early Design Support program provides early phase, direct funding to approved design firms to strengthen their capacity to create carbon-neutral projects specifically targeting impact across entire portfolios rather than individual projects.

Through case studies and knowledge sharing, the program advances carbon-neutral multifamily buildings by funding efforts in areas such as carbon neutrality, architectural design attributes, resiliency, non-energy co-benefits, embodied carbon and GHG reduction, innovations in design and construction, and economic effectiveness with scalability potential.

The goal of the program is to establish comprehensive carbon reduction frameworks that become standard practice in design, construction, and the industry at large, bolstering the marketplace to meet the challenges of clean, resilient buildings. The funds on Lincoln School were integral to determine the unit characteristics of implementing an all-electric Passive House project in Climate Zone 6 which provides unique challenges to the design industry.


More information about the Early Design Support program can be found [here](#).



Lincoln School Apartments

Project Location

The project on 1515 Knox St in Ogdensburg, NY provides a walkable and bikeable area for residents with a walkscore of 57 settled within existing Ogdensburg neighborhoods. The project is in climate zone 6 and has extreme cold weather in winter.



1515 Knox Street [Add scores to your site](#)

Ogdensburg, New York, 13669

Commute to **Downtown Ogdensburg**

2 min 5 min 17 min [View Routes](#)

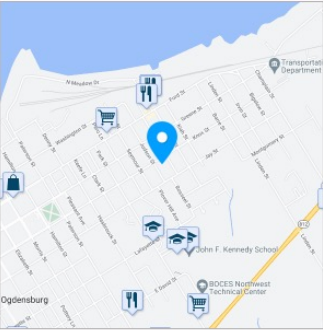
[Favorite](#) [Map](#) [Nearby Ogdensburg Apartments on Redfin](#)

[Looking for a home for sale in Ogdensburg?](#)

Walk Score 57 **Somewhat Walkable**
Some errands can be accomplished on foot.

Bike Score 41 **Somewhat Bikeable**
Minimal bike infrastructure.

[About your score](#)



1515 Knox St Walkscore

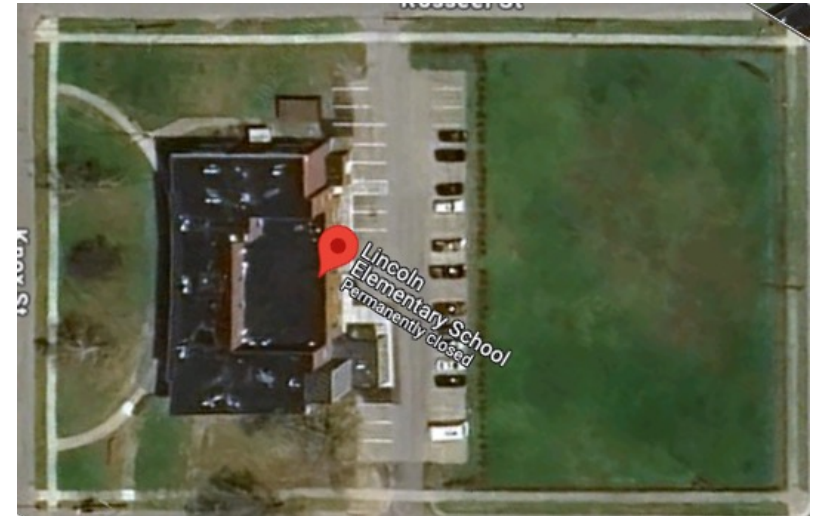


Fig: Existing Site Conditions – 1515 Knox St, Ogdensburg, NY

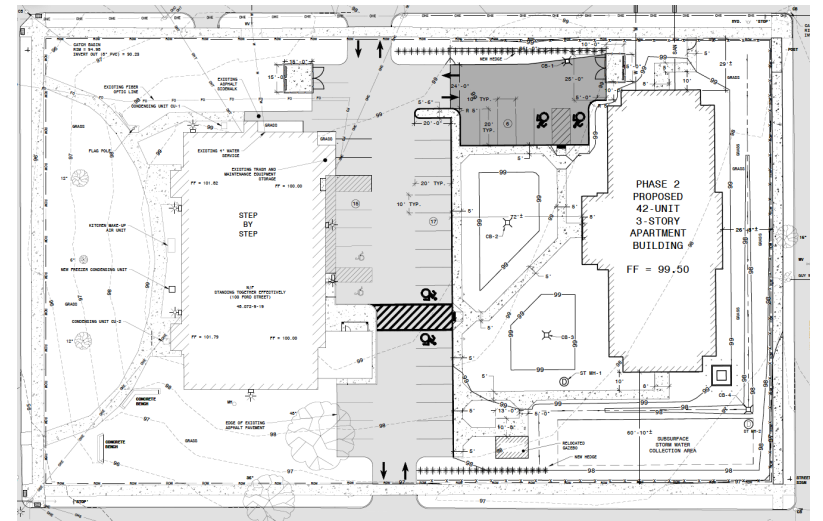


Fig: Proposed Site Plan – New 42 Unit Apartment
Drawings by Sanders Architects



Resiliency Assessment

Critical Risk Assessment

A four-part assessment (social, physical, functional, and strategy) was conducted on Lincoln School Apartments to satisfy funding requirements and assess any risks. The FEMA census tract view database determined the critical risk factors based on community resiliency, social vulnerability, and annual loss in St. Lawrence County. Based on those critical risk factors, the team implemented an efficient envelope and community resiliency spaces. These strategies will improve the resiliency of the community, building, and environment.

Top 3 Climate Risks

Cold Wave – Cold waves cause extremely low temperatures and can impact power grids, HVAC systems, and greatly impacts older populations

Ice Storm – Ice storms can disrupt travel, interrupt building and community power systems, and damage property

Landslide – Landslides can result in large damage to communities and infrastructure

Strategies

Energy Efficient Envelope – Reduce overall energy use while maintaining stable temperatures and temperature swings in the building, reducing electrical peak loads on building and grid

Community Resiliency Spaces – Provide a community room in the building to gather residents in times of disruption

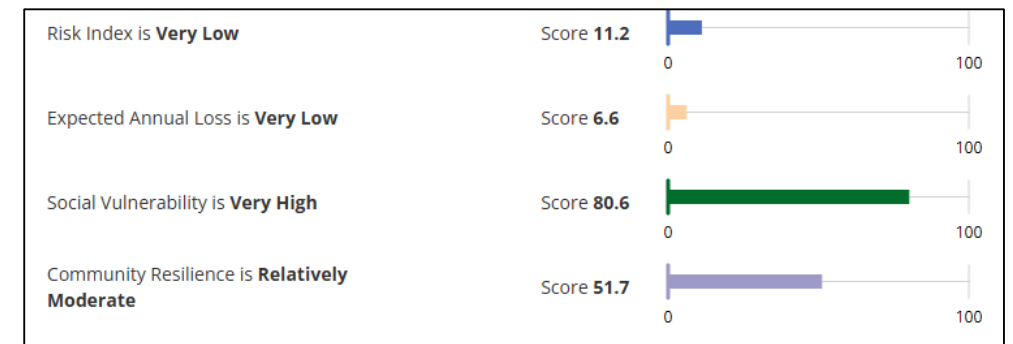


Fig: St Lawrence County Vulnerability Assessment



Why Explore Passive House?

To achieve 5 points in the Green Building Innovation Category for the competitive Federal Home Loan Bank funding, the project selected Passive House Institute US (Phius) Certification program. The project being affordable housing and located in the northern region of NY, it was critically important to have an energy efficient envelope to reduce operating costs. The \$750,000 Federal Home Loan Bank funding is critical to the projects being able to achieve this level of efficiency.

Passive House Summary

Early design decisions start with using examples of previously completed projects. Due to a limited number of Climate Zone 6 examples, the project followed an early feasibility process to review overall insulation concepts to meet Phius targets.

Building Envelope

- High-performance continuous insulation and envelope detailing at all walls, roof, and slabs
- Wood frame flat roof construction type
- Air-tight construction with fluid / factory-applied air barriers
- Reduction of thermal bridging
- Triple pane air-tight windows and doors

Systems

Heating and Cooling:

- 1 to 1 Fujitsu Air Source Heat Pump – Ductless distribution

Ventilation:

- Units: Semi Central ERV – Zehnder ComfoAir 350
- Common Space: Zehnder ComfoAir 450

DHW:

- Semi Central Heat Pump Water Heaters: Sanden

Appliances:

- ENERGY STAR® appliances, LED lighting and low flow plumbing fixtures, exhaust dryers - located outside the Passive House envelope

Renewables:

- Designated area for PV – 16.7 kW Rooftop Solar Array



About Passive House

Passive House optimizes heat gains and losses through sophisticated energy modeling to maximize comfort, health, and efficiency. The five core building science principles of Passive House are:

- Continuous insulation throughout its entire envelope without any thermal bridging.
- The building envelope is extremely airtight, preventing infiltration of outside air and loss of conditioned air.
- Employs high-performance windows (double or triple-paned windows depending on climate and building type) and doors - solar gain is managed to harness the sun's energy for heating purposes in the heating season and to minimize overheating during the cooling season.
- Uses some form of balanced heat- and moisture-recovery ventilation.
- Uses a minimal space conditioning system.

Superinsulation and airtight construction provide unmatched comfort even in extreme weather conditions.

Continuous mechanical ventilation of fresh filtered air provides superb **indoor air quality**.

A comprehensive systems approach to modeling, design, and construction produces extremely **resilient buildings**.

Passive building principles offer the **best path to Net Zero and Net Positive** buildings by minimizing the load that renewables are required to provide.

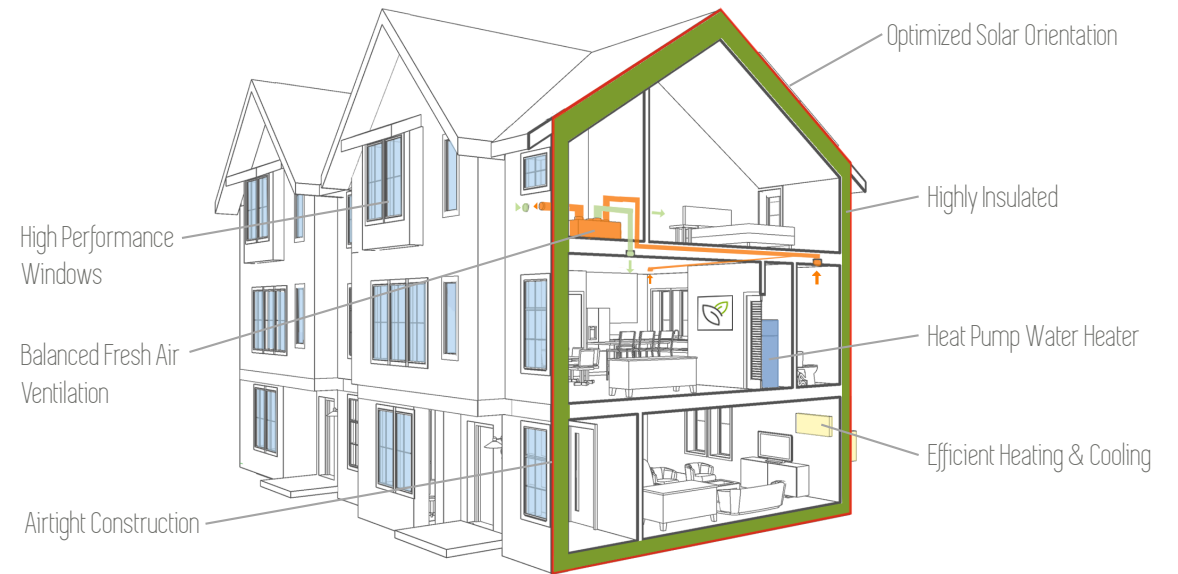


Fig: Passive House Principles



Passive House Homeowner Benefits

People spend 90% of their time in buildings and increasingly more time in their own homes. Noise, thermal comfort, and indoor air-quality have significant impact on our overall health, wellness, and productivity.

Durability

- Proven and applied building science strategies result in **increased building durability** and reduce the need for repairs and maintenance.

Health and Wellness

- The well insulated building envelope and triple pane windows, coupled with continuous fresh and filtered air provide the ultimate experience of comfort to occupants. Benefits include, **Noise Reduction, Superior Thermal Comfort and the best in Indoor Air Quality.**

Cost

- The climate specific and optimized energy balance of Passive House **reduce utility costs** and the overall cost of ownership over the life of the building. This also shields against fluctuating energy costs and eventual time of use utility costs.

Passive Survivability

- With the additional insulation and air-tight construction, during power outages or extreme weather events the temperatures inside will stay more comfortable for longer periods and be less prone to extreme temperature swings.

Energy Independence

- Fluctuations in the natural gas market will continue with regulations and disruptions such as the COVID-19 pandemic which has hit natural gas supply and pricing. The reduced building energy needs will limit impacts of future utility cost increases. Integration of PV would also contribute toward energy independence.



Typical Floor Plan

At the start of early design, the architect determined the needs of the building to serve a homeless population and the needs of the client. The studio apartments are driven by HHAP housing and provides stable living environment for the residents and a safe and healthy place to live.

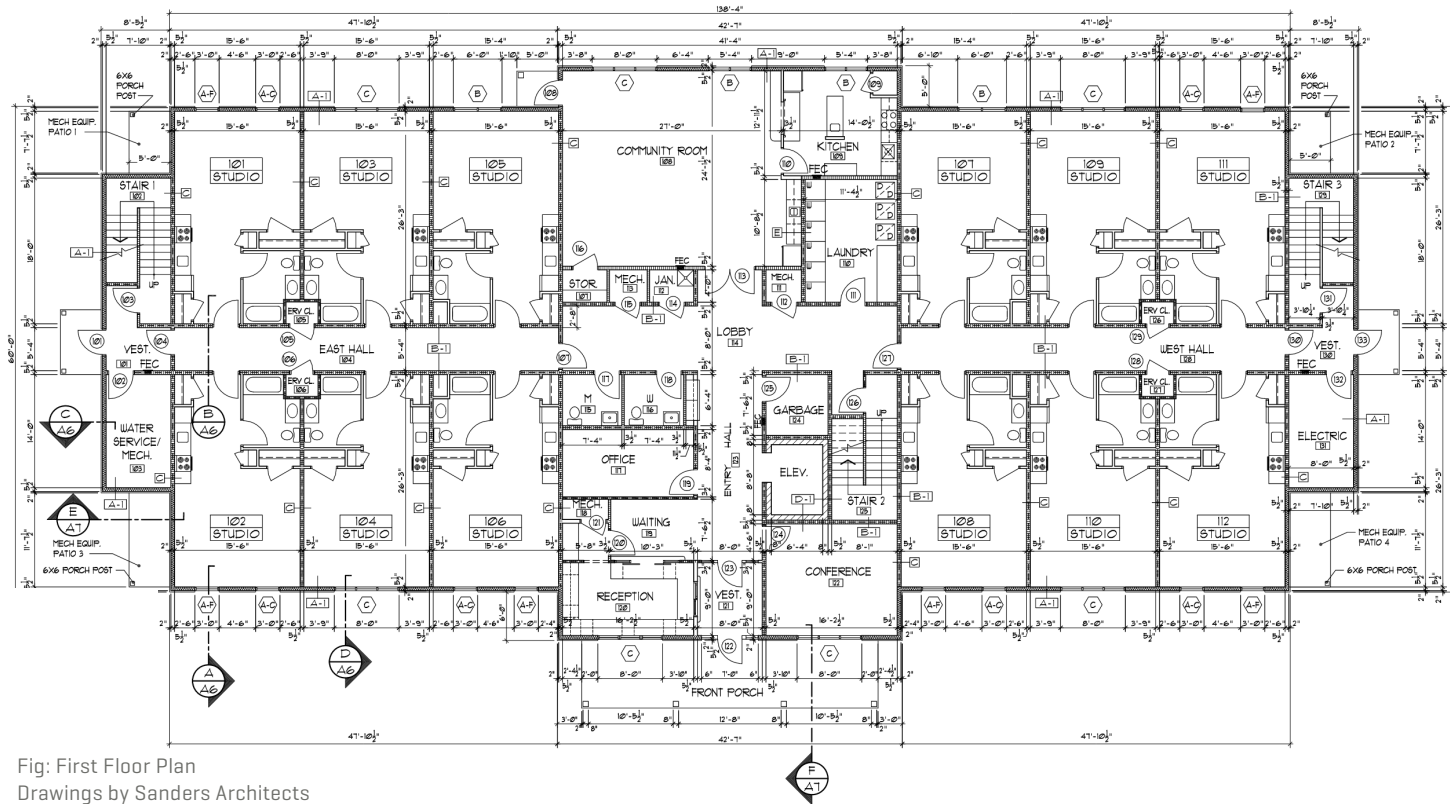


Fig: First Floor Plan
Drawings by Sanders Architects

Gross Area by Floor	
First Floor Plan	9,340 SFT
Second Floor	9,496 SFT
Third Floor	9,496 SFT
Grand Total	28,332 SFT

Residential Unit Totals	
Studio	36
1 Bedroom	6
Residential Unit Total	42



Integrated Design Process

The project team has followed an integrated design process and conducted preliminary energy modeling to determine how to best achieve Phius Certification following the process below.



Goal Setting Meeting: Identify major funding sources and project goals. Location and community resource availability drive critical decisions.



Develop Energy Road Map: Use existing programs such as NYSERDA, Phius, and Energy Star to assist process.



Preliminary Energy Modeling: Perform energy modeling to refine building massing, location, insulation and system design.



Feasibility Study and Design Review: Identify major buildings systems, costs, and incentives to move forward, and include design reviews from all impacted parties.



Construction: Iterate major systems early to reduce costs.



Passive House Institute US (Phius) 2021 Targets

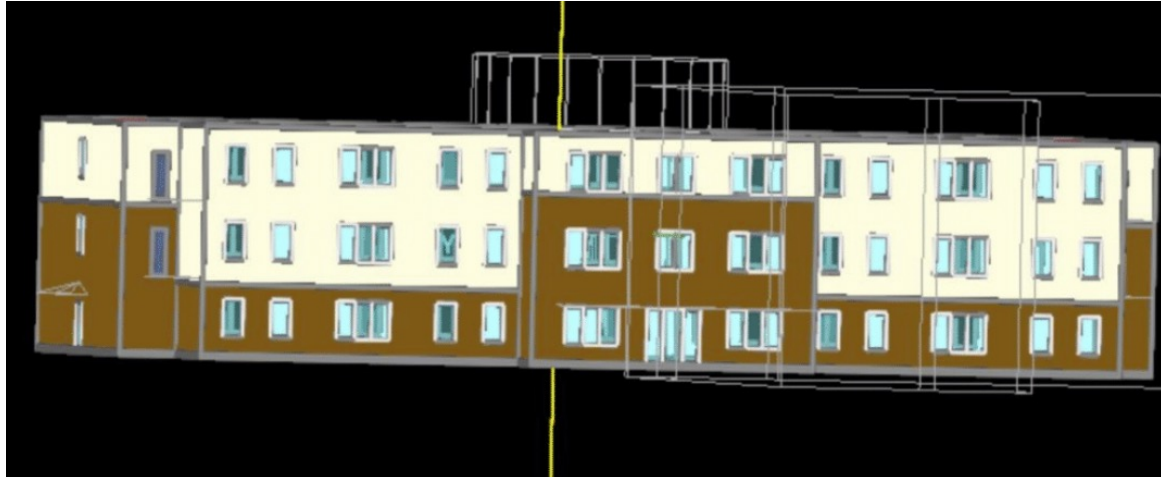


Fig: WUFI Modeling Geometry

Passive House establishes climate specific targets for buildings based on occupancy density and building massing.

These are used as the primary guideposts for early design decisions!

Building Information

Dwelling Units	42
Occupants	48
Conditioned Floor Area [iCFA]	27,395 ft ²
Envelope Area	34300 ft ²

Heating/Cooling Targets

Annual Heating Demand	7.0 kBtu/ft ² yr
Annual Cooling Demand	5.1 kBtu/ft ² yr
Peak Heating Load	5.0 Btu/ft ² hr
Peak Cooling Load	2.1 Btu/ft ² hr

Source Energy	7675 kWh/person/yr
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Air Tightness Whole Building Testing	0.06 CFM/ft ² @50 Pa
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Preliminary Energy Modeling

The initial design meetings create an initial concept design with target insulation levels and mechanical systems and the first energy model is created. This design was close to meeting all Phius targets but failed to meet the heating load target initially due to the Climate Zone 6 impacting heating load on the building.

Original Effective R-Values Modeled		
Under Slab Insulation	R- 10	2" XPS
Slab Edge Insulation	R- 10	2" XPS
Walls to Exterior	R- 28.5	2x6 wood Studs with 5.5" Batt insulation + 2" Zip R-9.6 Exterior insulation.
Roof	R- 60 min	Blow-in insulation
Windows	U- 0.169	Wythe Stuyvesant [basis of design]
Doors	R- 2.44	Opaque HM

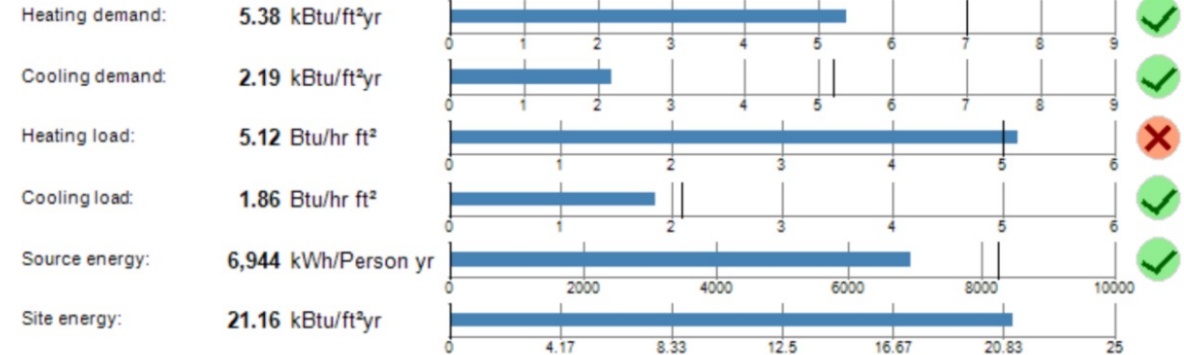


Fig: Preliminary Modeling Results



Modified Design and Modeling Results

After the first preliminary energy modeling the team worked together to identify potential additional measures to reduce the heating load of the building at Design Development stage. The early-design funding allows us to utilize these assemblies and construction techniques for other projects located in Climate Zone 6 in the future.

Modifications:

- Unitary ventilation rates were reduced from 55 CFM to 50 CFM per dwelling
- Eliminated perimeter thermal bridge
- Above grade wall insulation increased:

Modified Effective R-values Modeled		
Walls to Exterior	R- 32	2x6 wood Studs with 5.5” Batt insulation + 2.5” Zip R-12.6 Exterior insulation.

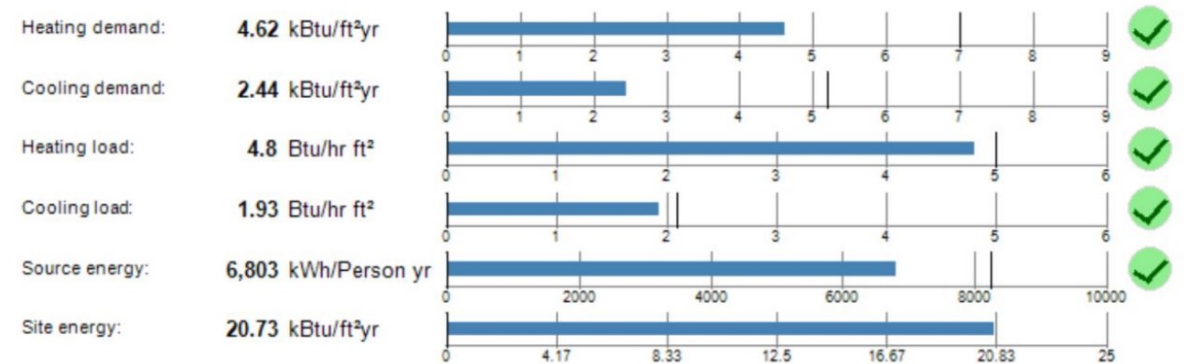


Fig: Modeling Revision 2 Results – Meeting Phius Standards

Additional Considerations:

- Please note that as the design evolves the energy balance of the model may change and modify recommendations



Under-slab and Slab Edge Insulation

The originally designed slab edge detail is a thermal bridge and a potential condensation risk. We recommended eliminating this thermal bridge completely because of how tight the heating target is. To achieve this, additional vertical insulation on the exterior as well as horizontal insulation for a minimum of 4 feet as shown below in the thermal bridge free detail.

Recommended Modification:

- **Slab:** R-10 continuous under slab insulation – 2” Rigid XPS under 8” Gravel.
- **Slab edge insulation:** R-10 wrapped down exterior foundation wall connecting with exterior rigid wall insulation

Original Detail

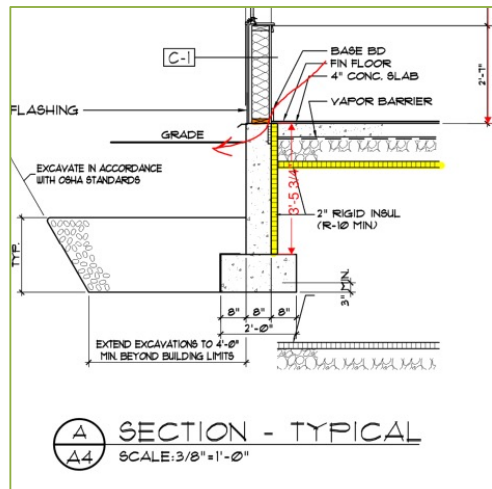
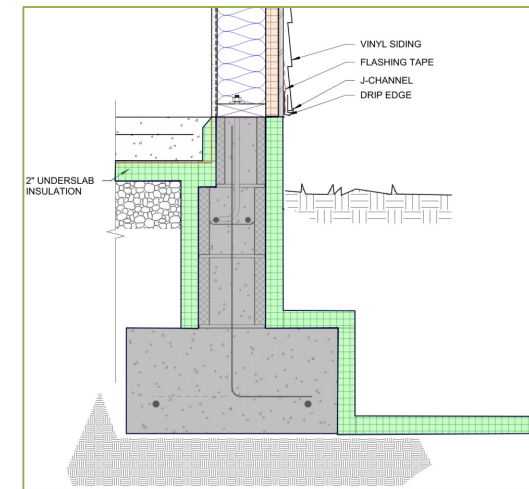


Fig: Section Detail
Drawing by Sanders Architects

Thermal Bridge Free Detail



Wall Assembly

Above Grade Wall Assembly

2 x 6 Wood Stud Walls: 2" Zip Sheathing [R-9.6] as shown in the drawing archives a total R-value of 28.5 for the wall assembly. Changing the exterior continuous insulation to 2.5" Zip Sheathing [R-12.6] results in a total R-value of ~ 32, which helps meet the heating load targets. This change is driven by the more stringent requirements and extra heat loss in climate zone 6.

Recommended Modification:

- R-12.6 Zip-R Sheathing, 2.5"
- Closed cell foam insulation at rim/band joist to maintain

Original Detail

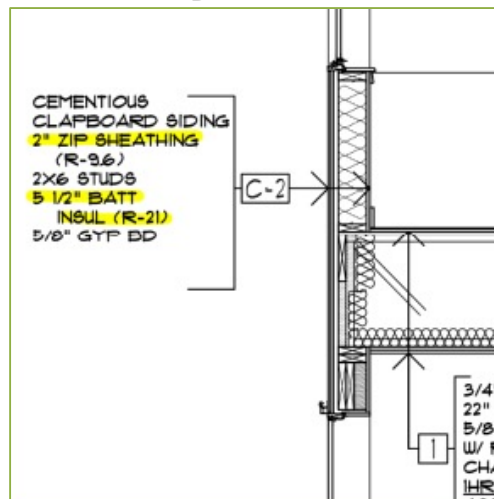
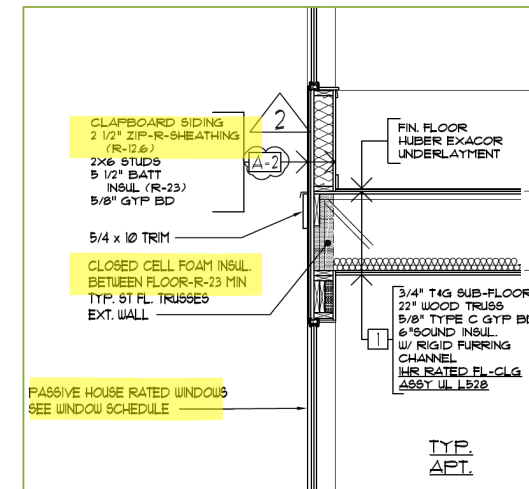


Fig: Section Detail
Drawing by Sanders Architects

Higher R-Value Detail



Exterior Insulation Options

The ZIP-R assembly was determined by the team for its combined ability to provide a weather and air barrier, an integrated structural sheathing, and insulation. The product includes polyiso insulation at 2" to achieve R-12.6. Other product options and their respective embodied carbon characteristics are shown below:

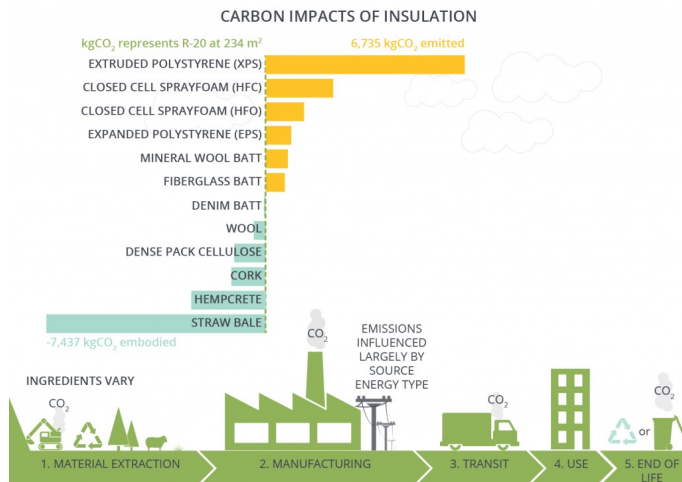
- Polyisocyanurate:** Aged R-value ~ R-6 per inch, vapor impermeable
- Extruded Polystyrene [XPS]:** R-5 per inch, vapor semi-permeable
- Graphite Polystyrene [GPS]:** R-5 per inch, vapor semi-permeable
- Expanded Polystyrene [EPS]:** R-4 per inch, vapor semi-permeable
- Rockwool:** R-4 per inch, vapor permeable, fire resistant
- Wood Fiberboard:** R-3.6 per inch, vapor semi-permeable

PROS

- Highest R-value per inch
- High R-value/inch
- EPS with improved R-value, source locally
- Best option for foam insulation
- Hydrophobic, not petroleum based
- Natural Material, Positive carbon sequester

CONS

- Vapor closed, retains water
- High global warming potential
- Less common
- Lower R-value
- Cost
- Thicker wall, availability



Exterior Insulation for R-12 Exterior	
Thickness Required	Type [R per Inch]
2.5"	XPS / GPS [R-5]
2"	Polyisocyanurate [R-6]
3"	EPS [R-4]
3"	Rockwool [R-4]
4"	Wood Fiberboard [R-3]



Roof Assemblies

The original detail called for a vented attic with roof truss system and 18" Batt Insulation [R-60] over 5/8" Type C Gyp board. Recommendations and final details shown below.

Recommended Modification:

- It may be difficult to achieve grade 1 installation with batts between framing. Consider loose fill blown in cellulose insulation.
- Indicate what the air barrier at the attic will be and fully detail and sequence air barrier installation at ceiling.
- Call for insulation baffle at soffit vent and closed cell foam at edge of attic.

Original Detail

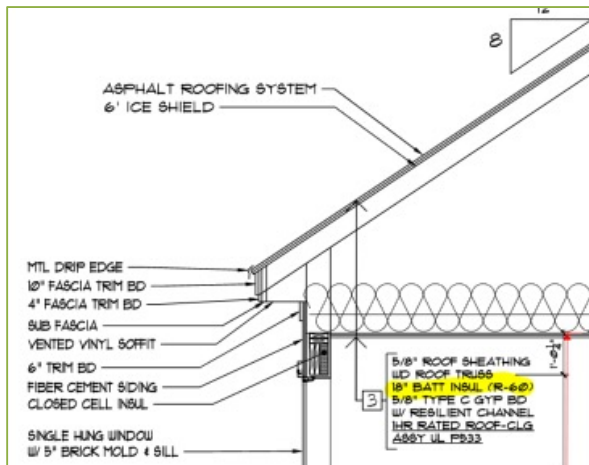
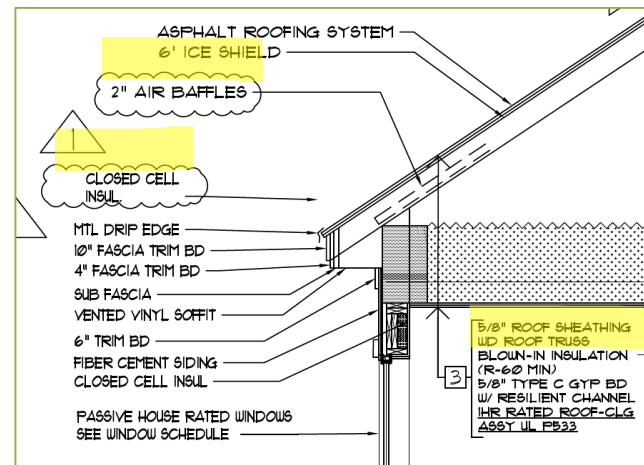
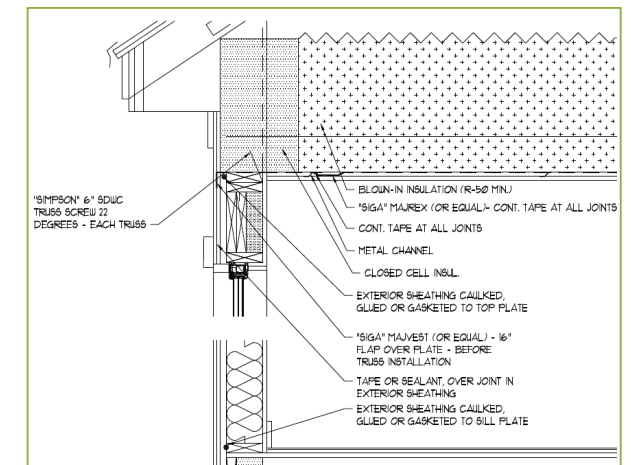


Fig: Section Detail
Drawing by Sanders Architects

Revised Detail



Air Sealing Plan – A-0.1






Thermal Boundary

Major building connection points are potential thermal bridge locations. Conducting a red pen review and outline where all building assemblies meet can identify details to consider for thermal and air barrier continuity.

Potential Thermal Bridges

- Foundation to wall transition
- Wall to roof transition
- Siding attachments [Brick Ties]
- Canopy attachments

-  Additional detailing required for thermal-bridge-free construction
-  Thermal and air control boundary - 0.06 CFM/ft² @50PA
-  Compartmentalization boundary - 0.3 CFM/ft² @50PA

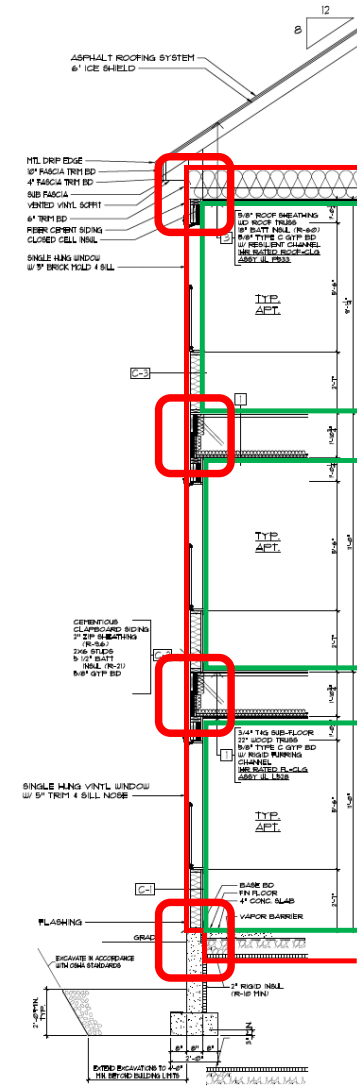


Fig: Original Wall Section
Drawings by Sanders Architects

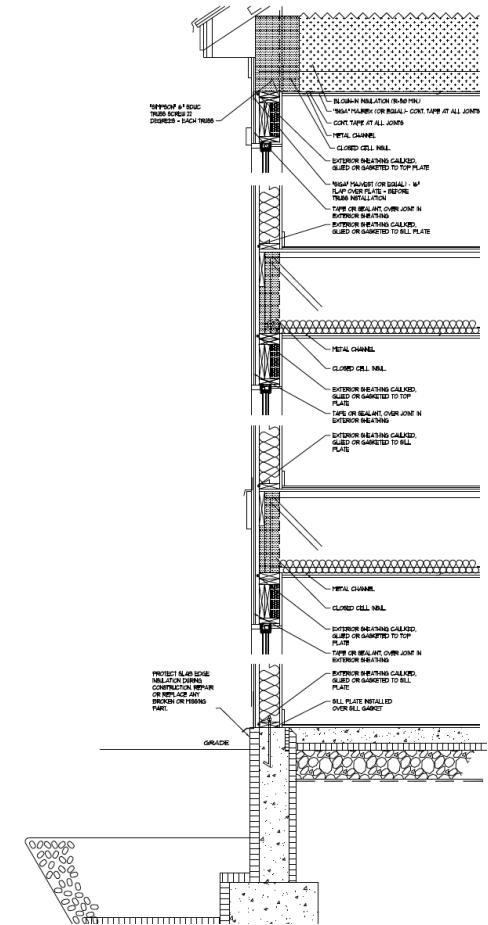


Fig: New Air Sealing Detail Plan

Thermal Bridges

Potential thermal bridges are analyzed for impact in THERM software, and recommendations provided to eliminate thermal bridge locations where possible.

Recommended Modification: It is best practice that anytime structural fasteners come through the exterior sheathing, to call for a coating of spray foam at the interior side of the fasteners to eliminate any risk of condensation.

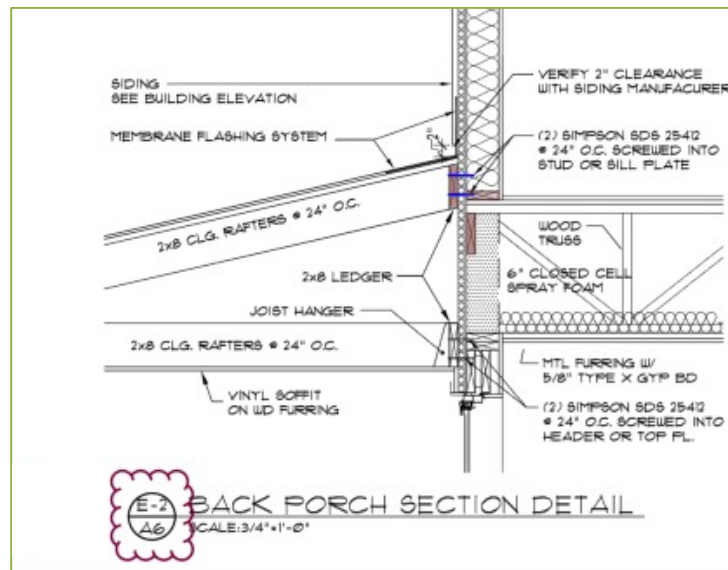
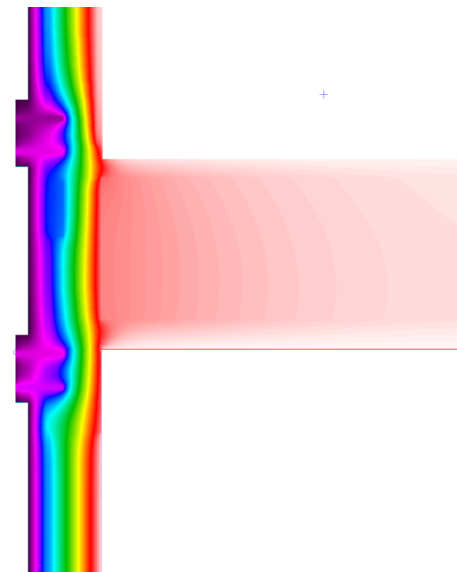


Fig: Back Porch Section Detail
Drawing by Sanders Architects



Psi for WUFI (btu/hr.ft.F)
0.191

*Psi is the heat loss of this thermal bridge input into the energy model. A positive number indicates a thermal bridge needing inclusion in the WUFI energy model.



Thermal Bridges

Not all thermal bridges are impactful enough to need to change and can be accounted for as energy loss in the model. The Thermal Bridge at the balcony junctions was analyzed, and the thermal escape PSI value was accounted for in the energy model. This can be the case due to structural constraints and must be assessed to reduce potential condensation concerns or energy use.

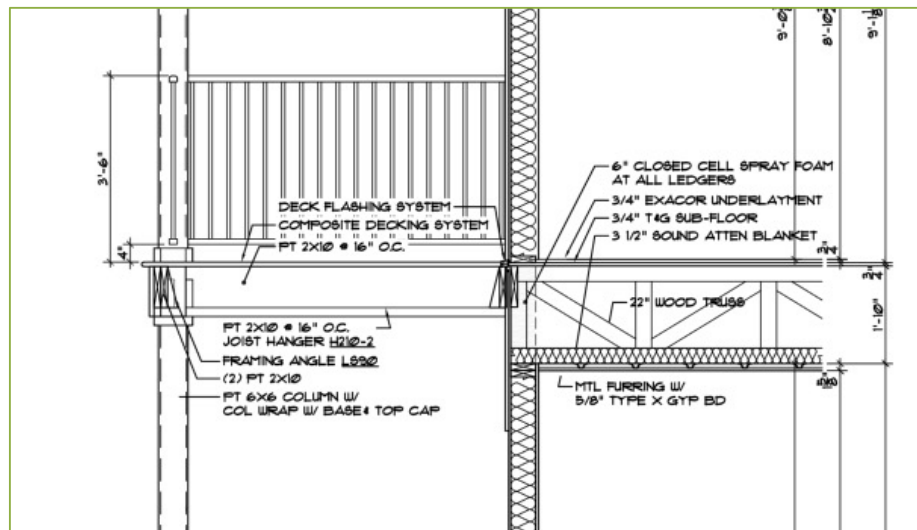
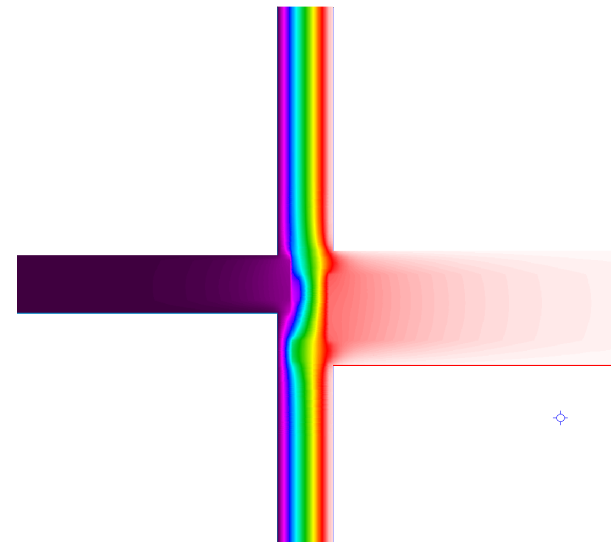


Fig: Exterior Wall w/ Porch Section Detail
Drawing by Sanders Architects



Psi for WUFI (btu/hr.ft.F)
0.113

*Psi is the heat loss of this thermal bridge input into the energy model. A positive number indicates a thermal bridge needing inclusion in the WUFI energy model



Window Performance

In heating dominated climates, Passive House requires triple pane windows to eliminate condensation risks and to meet stringent comfort criteria and heating targets.

General Window Recommendations:

- Triple pane windows are roughly R-5, exact specifications for each window can be analyzed as different manufactures are considered.
- Air-tightness is critical for windows. Tilt-turn or casement windows are recommended as they ensure a tighter overall window seal.
- Modeled frame-to-wall PSI value is 0.020 for center mounded condition.
- Shading from internal blinds modeled. Shades provided by owner help reduce excess heat gain in the summer and for comfort.
- [Phius Window Database](#) is not required but helpful to choose windows from this list.
- A 3" shading reveal is modeled, which is typical for new construction windows.
- ENERGY STAR® Storefront Window min performance.

Modeling Inputs – Lincoln School Min Eff	
Glass U-value	0.12
SHGC	0.34
Frame U-value	0.167 BTU/hr. ft ² F
Glazing-to Frame PSI	0.018
Frame-to-Wall PSI	0.02

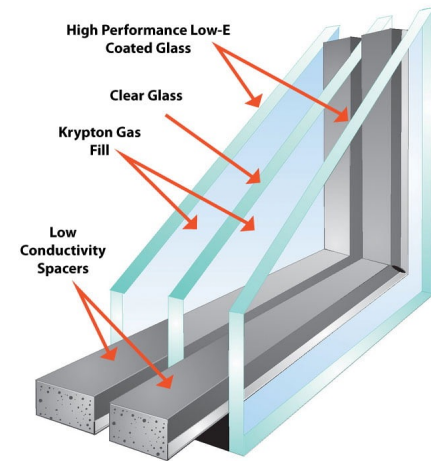


Fig: Triple Pane Window Features



Condensation and Comfort

The Phius Window and Door Comfort & Condensation Risk Assessment Tool calculates the minimum required window frame U-value to eliminate condensation risk, as well as the required whole window U-value for thermal comfort. These calculations are based on the climate of the project site, as well as the height of the window.

- Currently modeled Wythe, Stuyvesant Windows as the basis of design with whole window U-value of 0.1653 and SHGC 0.34.
 - Pella 250 Series windows were explored but they do not meet the comfort criteria.
- Operation of windows will need to be confirmed. Tilt/turn, casement, or awning is required for air tightness, the drawings show single-hung windows which will not provide the required air tightness for the building.

CONDENSATION RISK

ISO 13788: Low Thermal Inertia Elements

Input Data: <i>Class 2 typical</i>	Fenestration Type	Any other type of fenestration	
	Input humidity class here	2. Dwellings / Office	
	Frame U-Value	0.42	BTU/hr.ft ² .F
	Safety Factor	15%	
Result:	Risk acceptably low?	YES (Pass)	

COMFORT REQUIREMENTS

Applies to vertical fenestration in all project types.

For stacked windows, include the full height of all mullied windows.

Windows >16' in height have the same U-value requirement as 16' tall windows.

Window Vertical Height	5.3	ft
Required Whole Window U-value*	0.19	BTU/hr.ft ² .F

* Uninstalled whole window U-Value used. Do not include frame-to-wall psi-value for compliance.

- The modeled windows pass the Phius condensation risk and comfort requirements.
- Per the above condensation risk assessment, egress doors must meet the U-0.42 or better on a whole-door U-value basis / R-2.38.



Air Barrier Considerations

Lincoln School is utilizing the ZIP system for exterior air barrier and weather barrier. SCl recommends fluid applied air barriers based on past experience in verifying and installing air barrier products on Passive House buildings.

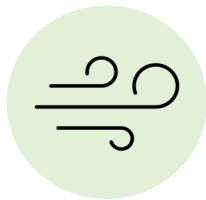
Air Barrier Options		
Type	Example Manufacturers	Considerations
Fluid Applied	Carlisle Barriseal, Prosoco, Sto	Fairly easy install and verification Well known manufacturers with easily integrated products Recommended for PH level envelope requirements
Factory Applied	ZIP System with liquid flash Armor Wall with liquid flash	Typically, a better seal than ZIP Tape Easily used on seams and incidental holes / fasteners
Factory & Field Applied	ZIP System with ZIP Tape	Requires attention to detail during install <ul style="list-style-type: none"> - Proper Lapping - Roller and adequate pressure necessary for adhesion - Tape can be tedious if used to fix damaged boards or overdriven fasteners
Mechanically Fastened or Self Adhering Barrier	Tyvek Henry Blueskin Siga Majvest Hunter VP-SA	Requires attention to detail during install <ul style="list-style-type: none"> - Proper Lapping - Taped seams Can be more labor intensive Not recommended for PH envelopes



Mechanical Systems: Basis of Design

Sustainable Comfort and Sanders Architects have previous experience with all-electric heating and cooling design in HHAP funded projects which include both ductless Air Source Heat Pumps and central Energy Recovery Ventilation (ERV) systems located in corridors. This design approach was reviewed initially and met the requirements on the Lincoln School project. The project uses higher efficiency Zehnder ERV systems due to the Phius considerations.

Special attention was paid to the all-electric hot water system, discussed on future slides.



Systems Modeled	
Heating and Cooling	FUJITSU Ductless Heat Pump Split System
Unit Ventilation	Zehnder ComfoAir 350 – one unit serves 2-3 dwellings
Common Space Ventilation	Zehnder ComfoAir 450
Kitchen Exhaust	Tied to central ERV, recirculating range hood
Domestic Hot Water	Semi Central Heat Pump Water Heaters, Sanden
Lighting and Appliances	LED and ENERGY STAR® where available
Solar PV	Designated Roof Area – 16.7 kW Rooftop Solar Array



Heating and Cooling

FUJITSU Ductless Heat Pump Split System

Unitary 1:1 heat pump systems per dwelling with ductless distribution with individual controls in unit. Small studio units can use a single ductless head. As bedroom count increases, ducted systems may be more effective.

Condensers located on mechanical balconies. In climate zone 6 this provides the benefit of keeping the condensers raised off the snow, protected from harsh elements, maximize space for solar on the roof, and reducing visual impact. Ensure proper air flow around exterior condensers.

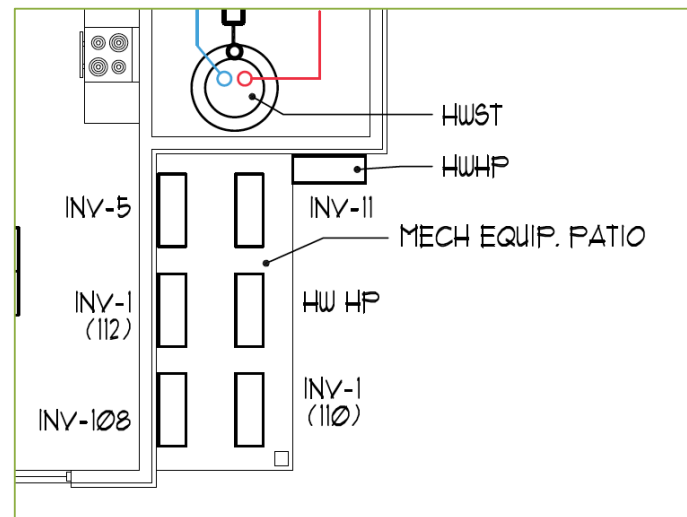


Fig: Exterior Condenser Location

Modeled System Efficiency:

- Heating: Basis of Design
 - COP @ 47F = 4.55
 - COP @ 17F = 3.13
- Cooling: Basis of Design COP = 5.4



Ventilation

Phius 2021 Requirements

- Merv 8+ Filters.
- Dedicated fresh air to all bedrooms.
- Ventilation inlet a minimum of 5' from exhaust and 10' from pollutants.
- Exhaust 20 CFM continuous from the bathroom and 35 CFM continuous from the kitchen. Supply minimum, 18 CFM per person.
- Kitchen exhaust: 6' minimum distance from cooktop.
- Total supply and exhaust shall be at least 100% of the design values and within 10% of each other; and no more than 10% greater than design values.
- Bedrooms shall be pressure balanced to +/- 1 Pa with respect to [WRT] the main body of the house with all other bedroom doors closed and the ventilation system running.
- Bedrooms shall be pressure balanced to +/- 3 Pa with respect to [WRT] the main body of the house with all other bedroom doors closed and the space conditioning system running.

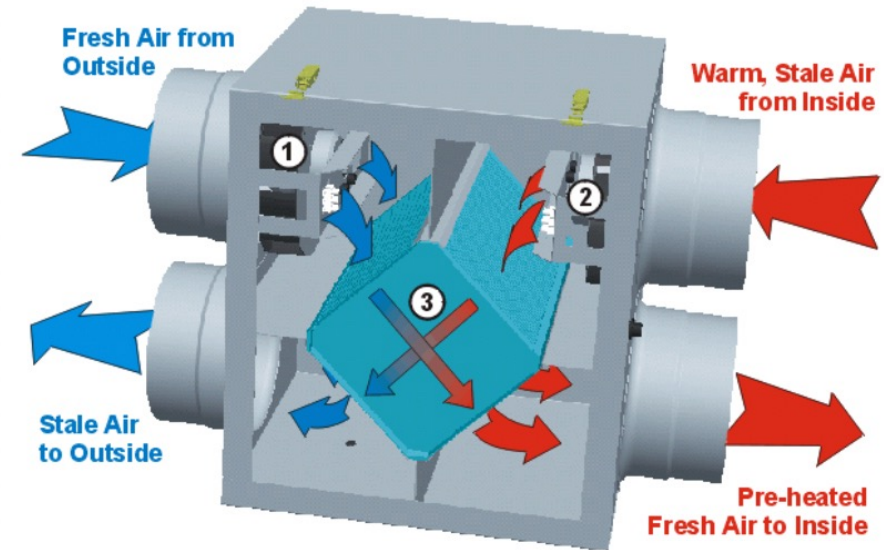


Fig: ERV diagram
Source: SQFT Studios

Ventilation

	Ventilation Summary
Unitary	Original Design 1 Bed - 55 CFM Original Design Studio - 55 CFM Modified to 50 CFM per dwelling unit to improve model
Common Areas	Specify units with summer bypass if able 2,500 CFM Common [MEP to provide actual] 1.250 CFM Trash Riser [MEP to provide actual]
Basis of Design	Zehnder ComfoAir350 and 450
Location	Inside PH envelope
Duct Insulation	R-12
Performance	85% modeled
Summer Bypass	Included with Zehnder Units

Recommended Modifications:

Ensure ventilation rates are appropriate for each unit size, keeping ventilation rates as close to ASHRAE 62.2 minimum flow rates can reduce energy use.



Ventilation Distribution System — ERV Location

The ERV Duct location can impact the heating and cooling use of the building due to losses through the outdoor air intake, and the exhaust air from the ERV. Locating ERV's close to exterior can benefit the energy model by minimizing the length of outdoor air ductwork and keep the ducts as short as possible to reduce thermal losses.

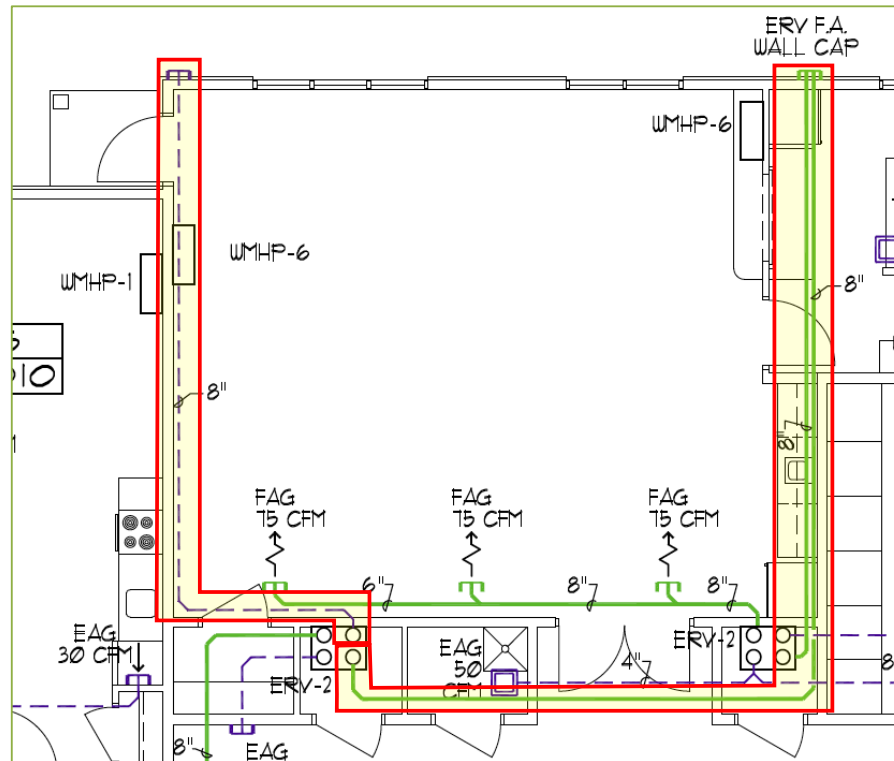


Fig: Example ventilation duct length

Recommended Modifications:

Take the closest possible route for the fresh air intake and exhaust, while maintaining the manufacturers required distance between intake and exhaust, or if none is specified a minimum of 10 feet



Hot Water Heating System Options

The team selected the Sanden SanCO2 to provide efficient all electric hot water generation due to their high efficiency in cold climates and use of CO2 refrigerants.

Electric Hot Water Heating Options		
Type	Example Manufacturers	Considerations
Integrated Heat Pump Water Heaters – In Unit	Rheem, AO Smith	Installs in unit, needs airflow to distribute cold air in space No central distribution or outdoor condensers Need to size loads for extra heating needs
Integrated Heat Pump Water Heaters – Semi-Central	Rheem, AO Smith	Located in shared room off the corridor Can handle 2-4 units off a single water heater Distribute evenly around the building and size extra heating
Central VRF	LG Hydrokit	Can take place of central DHW boiler plant Runs refrigerant outdoors and transfers heat to tanks Need large storage tanks, typically 2x the cost of boilers
Split System CO2 Heat Pump Water Heaters	Sanden San CO2, Mitsubishi QAHV, Aegis A Lync Model 350	High pressure CO2 creates hot water in outdoor unit Hot water piped into building storage tanks – insulate pipes Central or semi central configuration based on size of HP



Selected Hot Water Heating System

Selected System: Sanden SANCO2, 3.33 COP

- This is a semi-central design with one SANCO2 system per wing on each floor for a total of 6 SANCO2 systems. Outdoor units for the HPWH are located on mechanical balconies on each floor.
- In-unit distribution must meet the relevant DOE ZERH storage and time-to-hot requirement. To be reviewed when unit plans are available.
- Hot water piping increased cooling loads in the building, keeping distribution compact reduces energy use in the model.

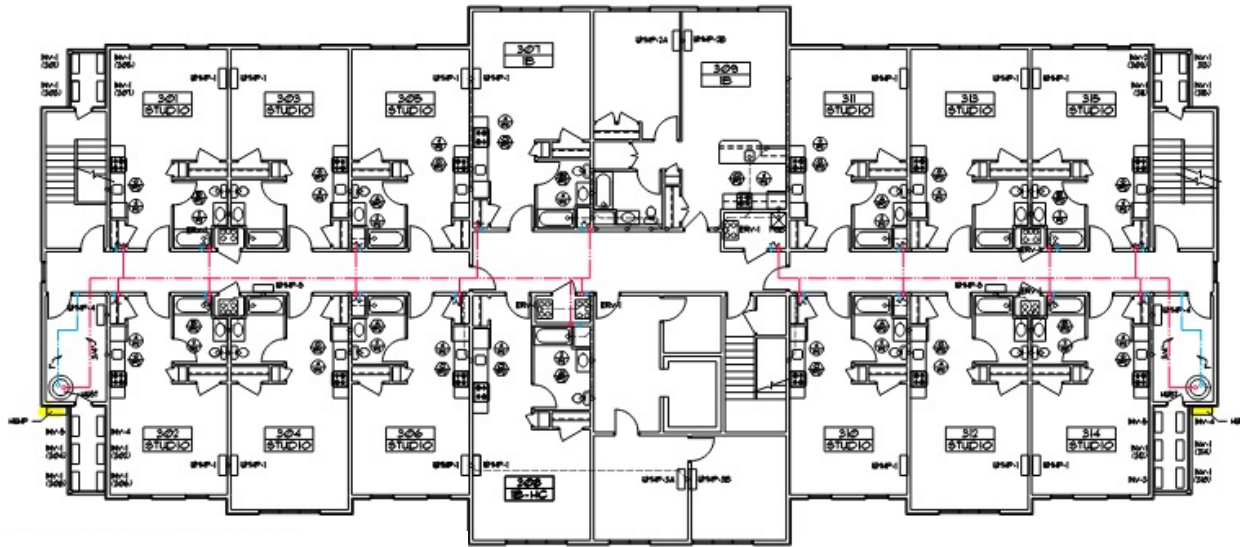


Fig: Third Floor Plumbing Plan
Drawing by Sanders Architects

- DOE Zero Energy Ready Requirement: Central distribution pump shall be temperature and demand based.
- Plumbing Fixtures: No specific requirements for flow rates, however, Plius encourages the use of all Water Sense labeled fixtures for toilets, lavatory faucets, and showerheads.



Lighting and Appliances

ENERGY STAR® Appliances

Refrigerators, dishwashers, clothes washers, and dryers to be Energy Star Qualified when installed.

Dryers

Central Laundry Room with Condensing Heat Pump Dryers. Condensing dryers eliminate the need for expensive makeup air systems and reduce exterior penetrations.

Electric Cooking

Induction cooking recommended. Induction reduces energy use but requires special cookware. Standard electric range and cooktops also an option.

LED Lighting

LED lighting throughout the building.

Occupancy sensors should be installed on all common area lighting, where deemed safe.

Appliance	Lincoln School Min Eff
Washer	120 kWh/yr / 4.5 ft ³ / 2.7 MEF
Heat Pump Dryers	5.79 CEF BOD
Refrigerator	360 kWh/yr
Dishwasher	269 kWh/yr
Cooking	Electric – non-induction
Lighting	Occupancy Sensors in Common Areas



Phius 2021 Electric Vehicles

Phius 2021 EV Charging Requirements [Guidebook, Appendix K]:

38 Spaces Total in the project

- 2 EV Ready spaces – space in panel & conduit & wiring
- 8 EV Capable spaces – space in panel & conduit

Total # of Parking Spaces	Minimum number of EV Ready Spaces	Minimum number of EV Capable Spaces
1	1	-
2-10	2	-
11-15	2	3
16-19	2	4
21-25	2	5
26+	2	20% of total

Table EV: Electric Vehicle Ready Space and EV Capable Space requirements

DOE ZERH EV Requirements - Applies to projects permitted in 2025:

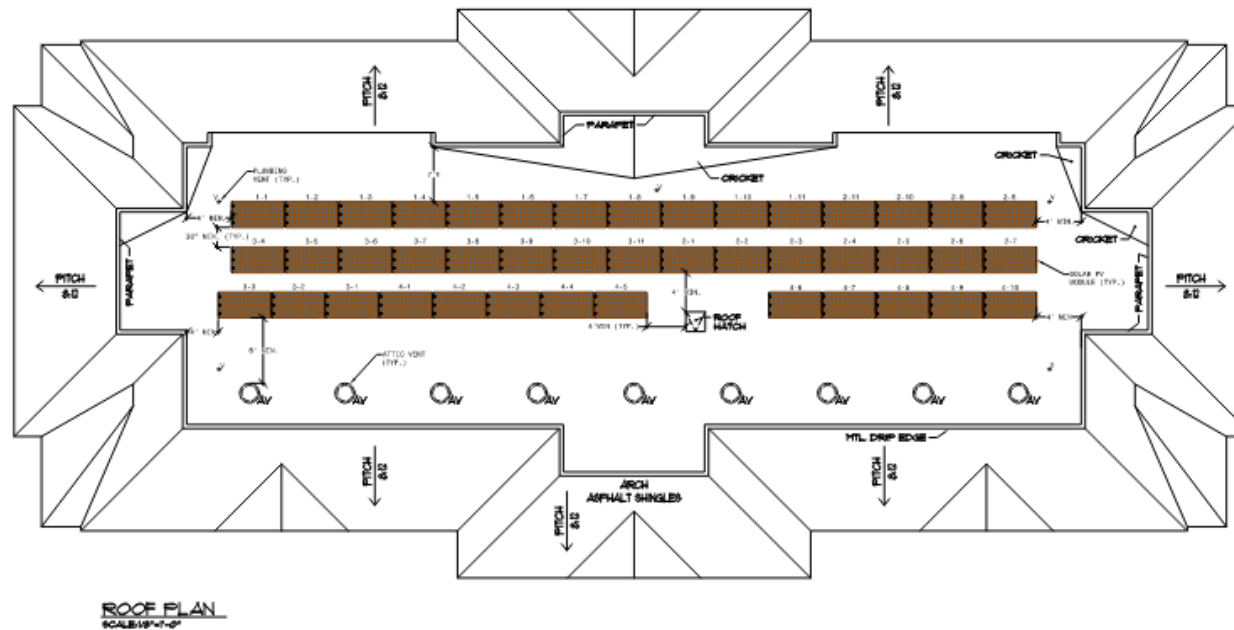
- Provide 10% EV Supply Equipment [charger with plug for car]
- Provide 30% EV Capable and Ready spaces [circuit ready]



Photovoltaic Array

There is designated space on the roof for a solar PV array. It is not yet determined if solar will be included in the project. Current results indicate it may not be needed to meet Phius Core 2021 and would be up to the discretion of the owner to reduce building operating costs. Potential state and federal tax credits can offset solar cost.

Potential Solar Roof Layout:



Drawing by Sanders Architects



Phius Certification Process Timeline

Schematic

- At Schematic Design prior to submitting to funding agencies and committing to specific energy programs, SCI suggests a Phius feasibility study to provide initial WUFI modeling for major inputs to inform project budgets and early design decisions

Design

- CPHC and Verifier provide design reviews at DD and CD stage and updated WUFI energy modeling
- Phius Design Certification: CPHC submits and can take 4+ rounds of review depending on how quickly feedback is resolved. SCI recommends having 2 rounds of review completed prior to 100% CD's. Feedback is returned:
 - 6-8 weeks for Round 1
 - 4-6 weeks for Round 2
 - 2-4 weeks for Round 3
 - 1-2 weeks for Round 4

Phius Design Certification Issued

Construction

- Phius Verifier inspects all required features, and provides whole building blower door testing, ventilation testing verification, and duct leakage testing

Occupancy

- Phius Verifier finalizes Energy Star, Indoor AirPLUS, and DOE Zero Energy Ready Certifications
- Phius issues Final Certification after verifying submission package. Expect certification in 60-120 post construction

Phius Final Certification Issued



Additional Cost for Phius Certification

Phius Certified Passive House Consultant (CPHC)

Hired by owner in early design and runs WUFI energy modeling, design reviews, and Phius Design Certification and Final Certification submissions.

- Sustainable Comfort serves as the CPHC for the project. Anticipated costs \$25-50k depending on project design complexity

Phius Certified Passive House Verifier

Conducts on site inspections, air leakage testing and third-party certification programs including HERS Rating, Energy Star Multifamily, EPA Indoor AirPLUS, and DOE Zero Energy Ready Homes

- Sustainable Comfort serves as Phius Verifier. Anticipate costs \$75-120k depending on project location, complexity of building layout

Phius Certification Fees

Paid to Phius to conduct Design Certification and Final Certification reviews. Lincoln School Fee: \$12,925. Certification fees charged by Phius depend on building size, typical guidance per the chart below with exact quotes provided per project.

PERFORMANCE PATH							
iCFA (sf)	<4,500	10,000	25,000	50,000	100,000	250,000	500,000
Single-Family	\$2,200		n/a				
Multifamily*	\$2,800	\$5,650	\$12,250	\$19,250	\$27,750	\$43,250	\$58,250
Non-Residential*	\$2,500	\$5,200	\$11,350	\$17,950	\$25,900	\$40,450	\$54,500
Estimated Rates* - Varies based on iCFA							

For inexperienced project teams, expect additional costs to the architecture team, and general contractor to learn and implement the concept of the program.



Additional Program Certifications

Along with Phius 2021 Certification, the following programs are also required for indoor health and comfort. SCl recommends the Rater/Verifier team be involved in all design review stages to capture any checklist requirements outside Phius review.

- EPA Indoor Air Plus
- Energy Star Homes/Multifamily
- DOE Net Zero Energy Ready Homes



Early Design Support Conclusion

The Lincoln School Project is supported with a NY state grant through the Homeless Housing and Assistance Program [HHAP] which provides the financing to provide housing and support services for homeless residents of the State of NY. Since these supportive projects will be held and maintained for a very long time, the need to maximize efficiency and provide carbon neutral attributes to meet the states climate goals is very strong. Since these state grants are limited, there is also a strong desire to minimize costs and leverage as many supplemental incentives sources as possible. The project received \$750,000 through the Federal Home Loan Bank program with Passive House commitment serves as a key feature to differentiate the project.

The utilities will be completely owner paid for the project and the Passive House commitment will reduce operating costs allowing more funding to support the residents. The Passive House feasibility process was able to provide the design team with a strong starting point to design and price the inclusion of Passive House and make the decision to commit to the program. Through the early design process the WUFI energy modeling was able to be optimized for insulation levels, any air sealing and thermal bridging details were able to be reviewed, and mechanical system selection were able to be optimized to achieve Phius Design Certification.

Special thanks to NYSERDA for providing the Early-Stage Design Funds on the project to support the additional research to apply Passive House design to Climate Zone 6, and summarize these findings on Passive House feasibility to design professionals through this report. Extra sources such as the BOE Early Design Support allow the project to have additional design support to maximize the efficiency and longevity of the project.

