PROJECT DOCUMENTATION
Private Residence with Secondary Suite
Victoria BC Canada
Passive House Low Energy Building – Building Directory ID 6767

1.0 Project Description

This 203m2 TFA custom residence with 3 levels, completed in December 2020, is located on a narrow 9.3m wide lot in a traditional urban residential neighbourhood. The lower level features a secondary one bedroom suite with exterior access and windows which can be rented out by the owner as an income source or occupied by extended family or aging-in-place owners in future while providing much needed local housing as encouraged by present City zoning. The home includes a garage for a single vehicle and workshop which is outside of the thermal envelope.

The owners were attracted to the Passive House concept for reasons of superior comfort, reduced long-term energy usage plus robust construction and components. They desired a contemporary home with excellent daylighting and open plan interior at the main level extending visually into a private rear garden.

While the north (street) and both side elevations have glazing limited to less than 10% of wall area due to BC Building Code restrictions for the 1.5m side yards, glazing on the south facing rear elevation is optimized for solar access and garden views. Summer shading on this side is achieved by an automatic retractable fabric canopy at main level controlled via an interior temperature sensor set at 25C or owner's discretion. A fixed aluminum frame and wood sunscreen is provided over the upper level south windows.

1.1 Building Data

Year of Construction	2020
U-value External aalls	0.122 – 0.161 W/m^{2}K
U-value Roofs	0.093 – 0.103 W/m^{2}K
U-value Floor over Garage	0.110 W/m^{2}K
U-value Basement Floor	0.137 W/m^{2}K
U-value Windows	0.79 W/m^{2}K
PHPP Annual Heating Demand	21 kWh/m^{2}a
PHPP Heating Load	12 W/m^2
Primary Energy Renewable (PER)	62 kWh/m^{2}a
Non-renewable Primary Energy (PE)	122 kWh/m^{2}a
Generation Renewable Energy	0 kWh/m^{2}a
Pressure Test n50	0.41 h-1
Effective Heat Recovery Efficiency	84.5%

Special features include solar ready electrical duct to main roof and green roof over main level living room.

1.2 Responsible Project Participants

Architect	James Kerr Architect http://kerrarchitect.ca/
Passive House Project Planning	James Kerr Architect http://kerrarchitect.ca/
Builder/Construction Manager	Interactive Construction Inc. https://www.interactiveconstruction.ca/
Energy Consultant	Reed Cassidy, Adapt Energy Advising https://www.adaptenergyadvising.com/
Structural Engineer	Skyline Engineering Ltd. https://skylineengineering.ca/
Geotechnical Engineer	Ryzuk Geotechnical https://www.ryzuk.com/
Landscape Design	Mustang Landscape & Design Ltd. https://www.mustanglandscape.ca/
Project Certification	Tad Everhart, CertiPHIers Cooperative https://www.certiphiers.com/
Certification ID	31809-31810_CCO_PH_20210923_TE

Author of Project Documentation	James Kerr Architect
Date	10 December 2021

Signature

2.0 Exterior Photos

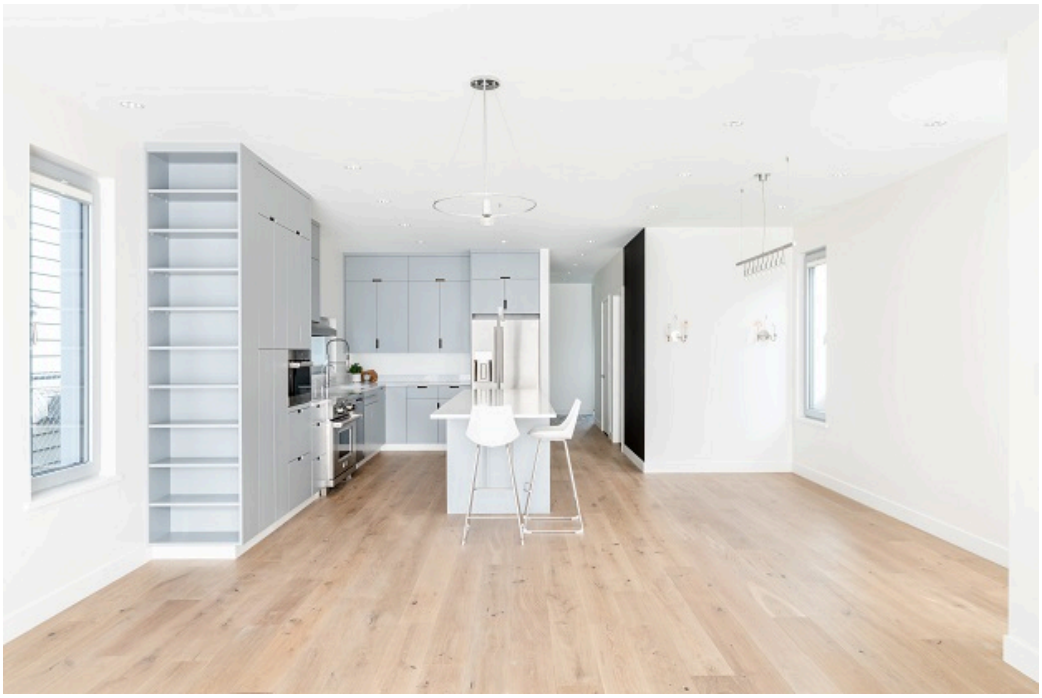
View of north & west elevations from street

View of east elevation. Glazing limited to <10% wall area on east & west elevations.

View of south elevation with shading devices & rear garden

View of extensive green roof over main level living room

3.0 Interior Photos



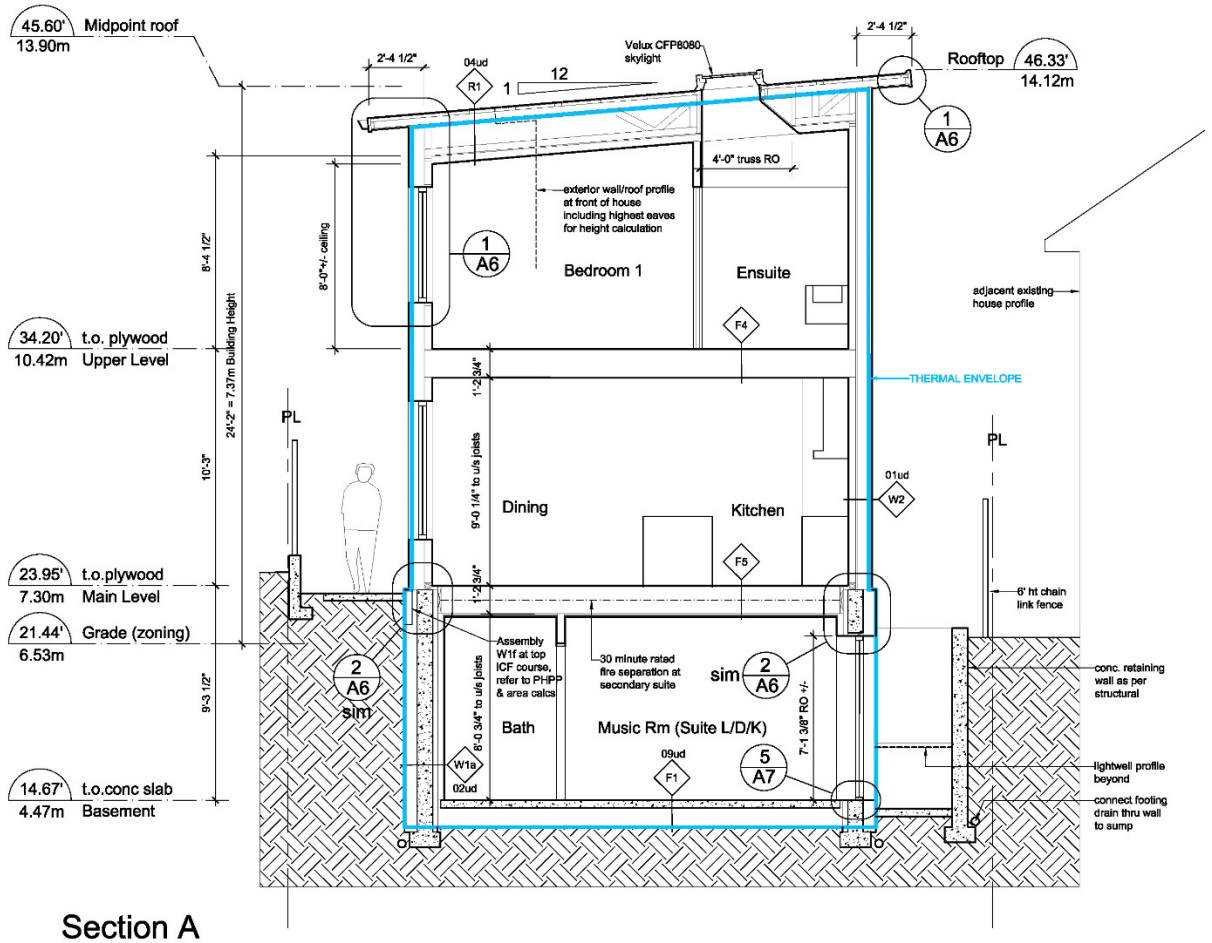
Views of living-dining-kitchen space

View of ensuite bathroom

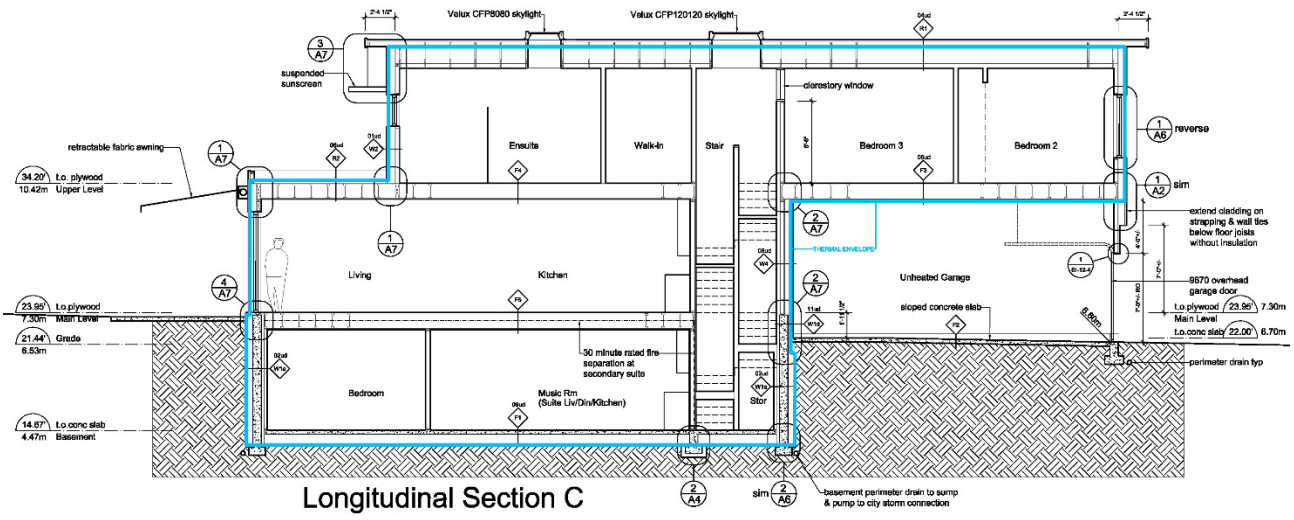
Views of interior stair

4.0 Building Sections

The house consists of a full basement plus 2 levels above grade. Due to the narrow property the built form is elongated in the north-south direction. Although existing adjacent residence to west is very close, there is good sun exposure along the south and east elevations. Insulation is provided in floor assemblies for acoustic separation, including between house and lower level suite, and for thermal reasons at perimeter.



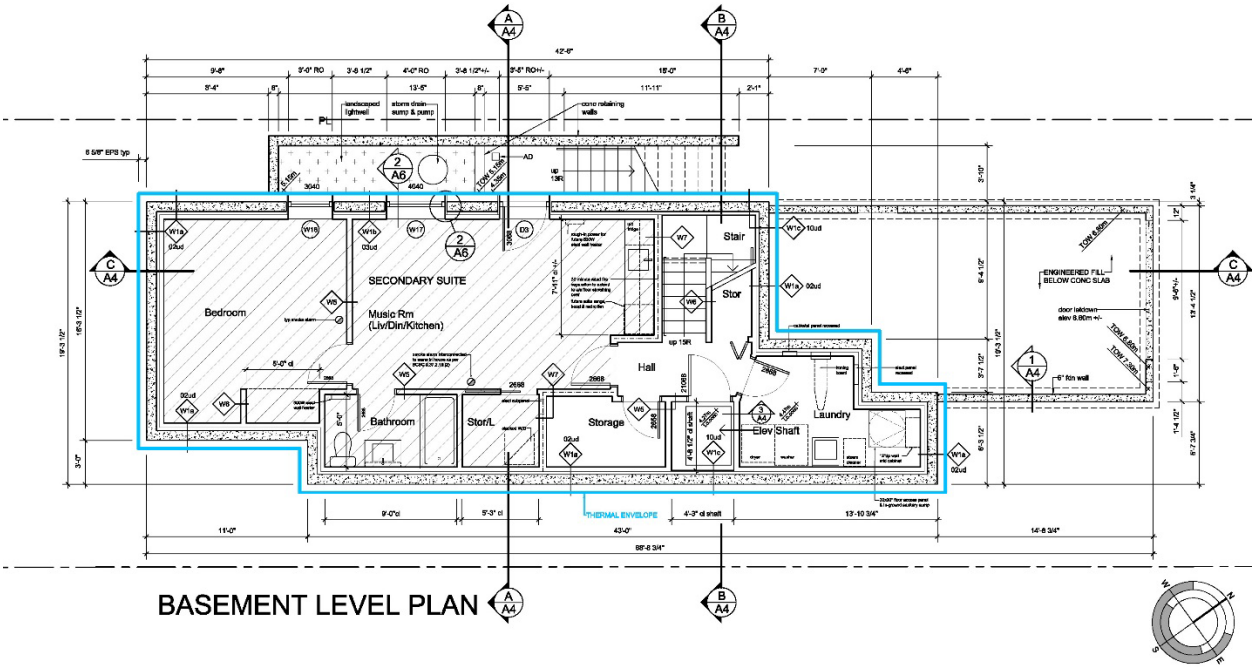
Section A



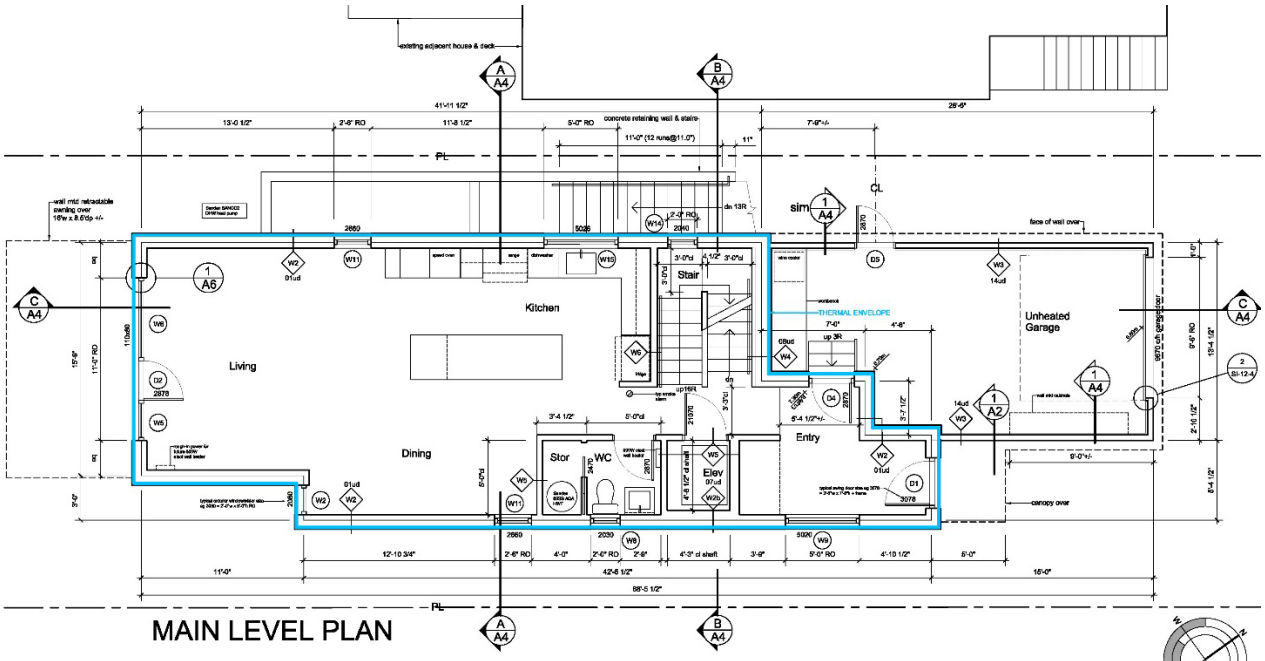
Longitudinal Section C

5.0 Floor Plans

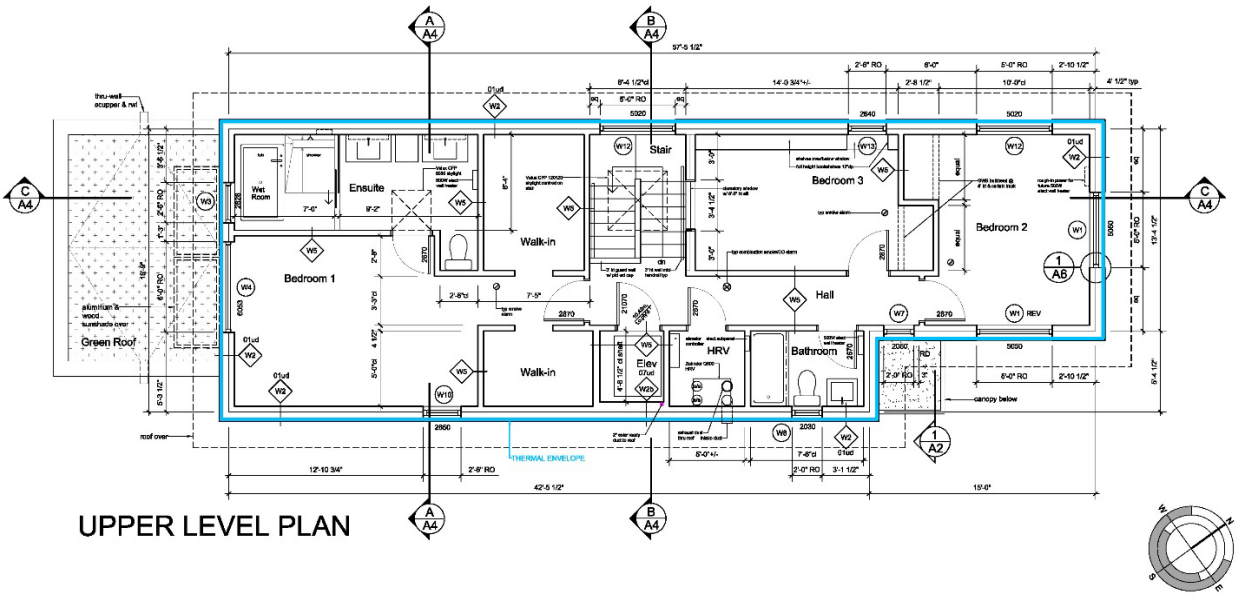
The main (ground) level features an open plan living-dining-kitchen space, street facing entrance courtyard and attached garage. The basement level houses a secondary suite with private entrance and laundry/storage for principal residence while the upper level has 3 bedrooms. A central stair with generous daylight and electric in-line drive elevator connect all 3 levels for occupants of all ages and those with mobility challenges.



BASEMENT LEVEL PLAN



MAIN LEVEL PLAN



5.0 Construction Details

Construction systems were chosen based on locally available materials & labour, cost effectiveness and ability to incorporate Passive House requirements for enhanced thermal insulation, airtightness and minimal thermal bridging. The full height basement was constructed using insulated concrete form (ICF) walls and concrete slab on grade. The upper levels were built of standard wood frame construction including prefabricated wall panels to speed assembly during winter months.

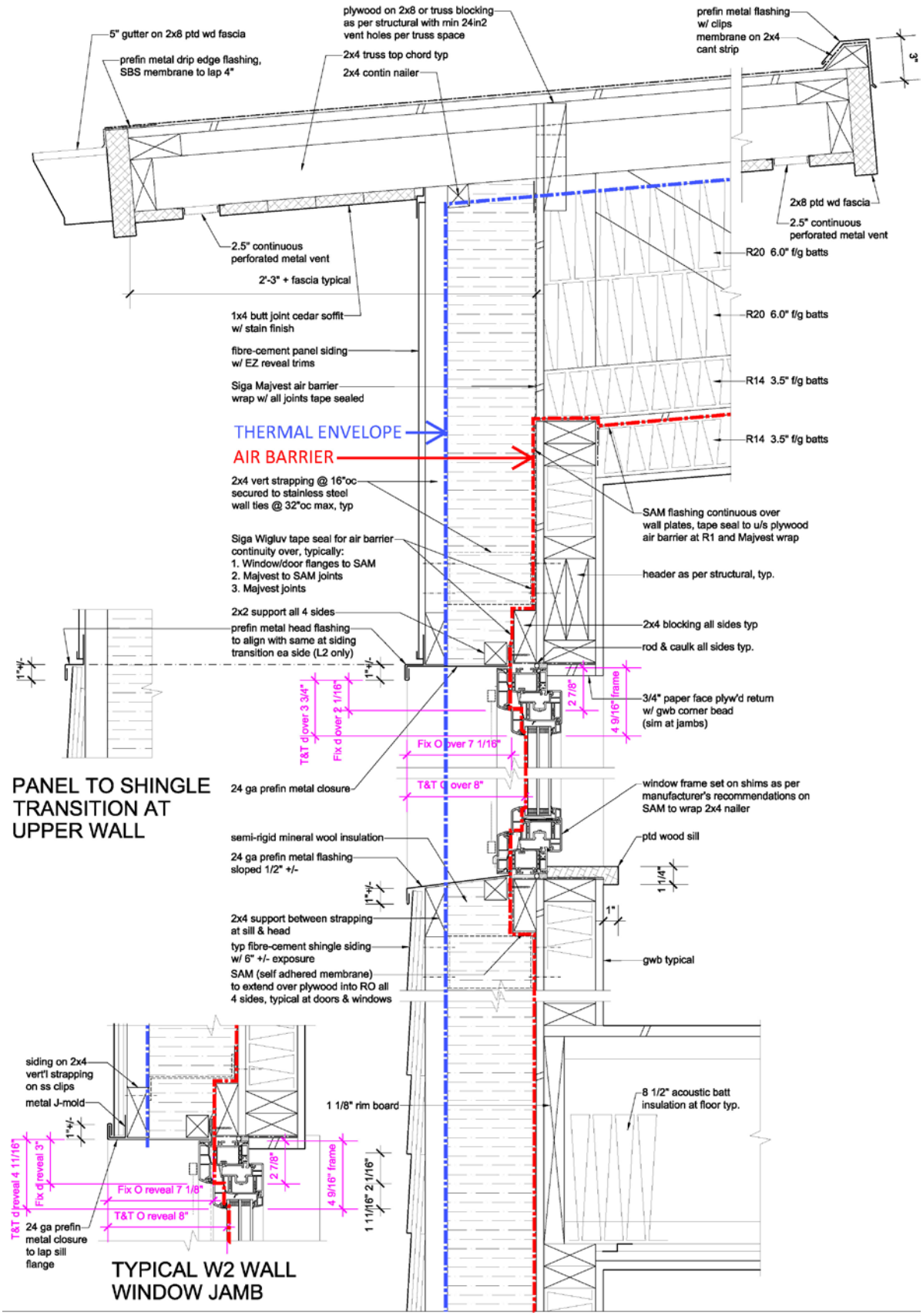
Exterior wall systems include minimum 150mm continuous exterior insulation outside of structural components and air barrier. 38x64/89mm framing on interior side of wall & sloped roof assemblies accommodate electrical & plumbing services to minimize air barrier penetrations.

Exterior Frame Wall
13mm gypsum board
38x89 wood studs @ 406mm oc w/ RSI 2.5 fiberglass batts
13mm plywood & Siga Majvest weather barrier w/ taped joints
152mm mineral fiber insulation & ACS stainless steel clips
w/ Proloft aerogel thermal break
38x89 vertical wood strapping @ 406mm oc
Exterior cement board cladding
U-value = 0.161 W/(m^{2}K)

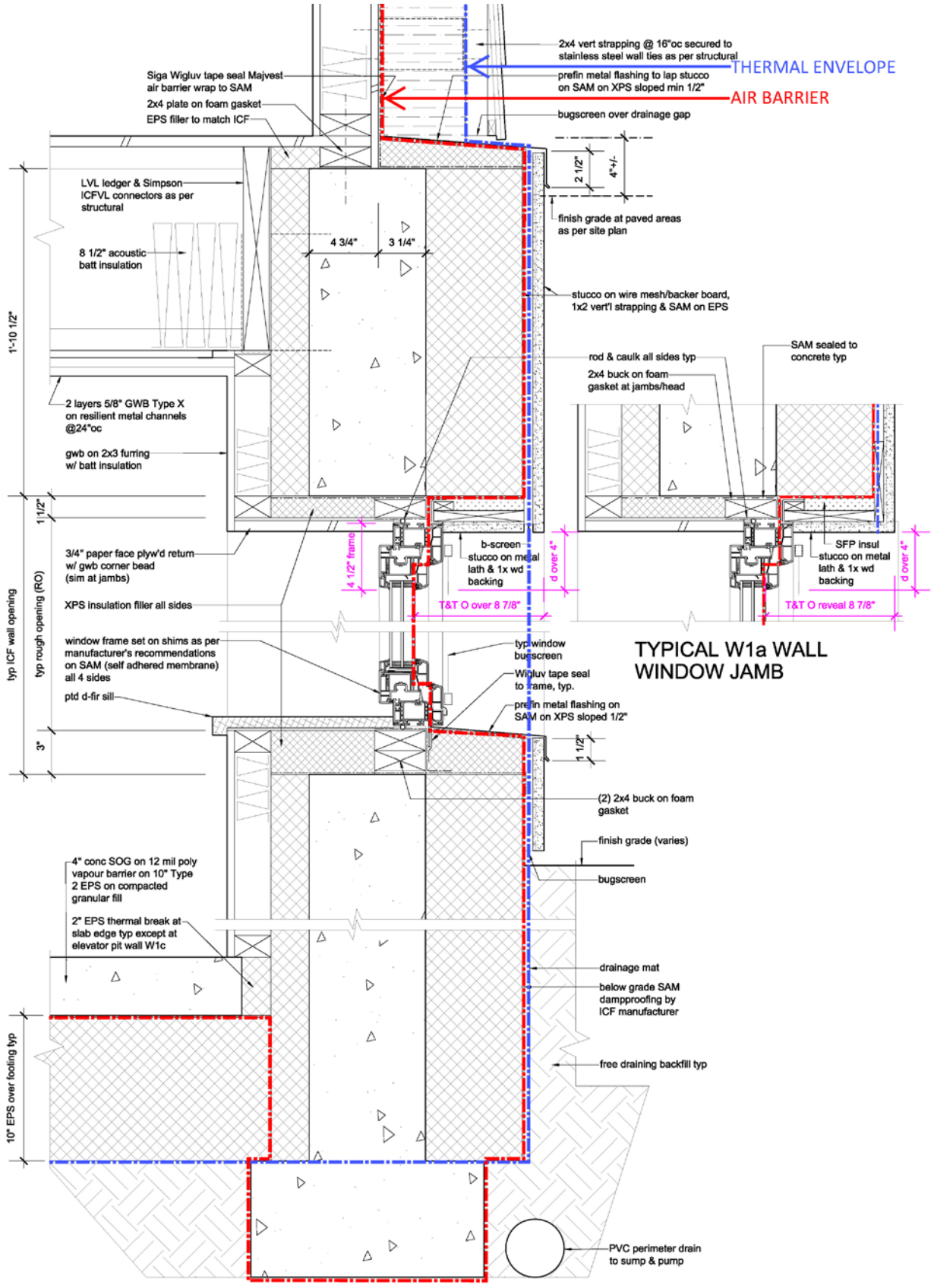
Exterior ICF Wall
13mm gypsum board
38x64 wood studs @ 406mm oc w/ RSI 1.4 fiberglass batts
67mm EPS Type 2 insulation
203mm reinforced concrete
168mm EPS type 2 insulation
Self-adhered membrane waterproofing
U-value = 0.124 W/(m^{2}K)

Sloped Roof Assembly	13mm gypsum wall board 38x89 wood furring @ 406mm oc w/ RSI 2.1 fiberglass batts 13mm plywood w/taped joints (air barrier) 508mm deep wood trusses @ 610mm oc w/ RSI 9.5 fiberglass batts Vented air space & 38x89 wood strapping @ 610mm oc 19mm plywood & 2-ply SBS roof membrane U-value = 0.093 W/(m^{2}K)
Roof Assembly (over Living space)	13mm gypsum wall board 381mm deep engineered joists @ 406mm oc RSI 9.5 spray polyurethane foam insulation 19mm plywood & self-adhered membrane air barrier 76mm (average) EPS Type 2 tapered insulation 2-ply SBS roof membrane U-value = 0.103 W/(m^{2}K)
Floor over Garage	Engineered wood floor finish on 19mm plywood 381mm deep engineered joists @ 406mm oc w/ RSI 9.5 fiberglass batts 13mm plywood w/taped joints (air barrier) 38x89 wood strapping @ 406mm oc 13mm gypsum wall board ceiling U-value = 0.110 W/(m^{2}K)
Basement Floor	102mm concrete 254mm EPS Type 2 insulation Polyethylene moisture barrier U-value = 0.137 W/(m^{2}K)

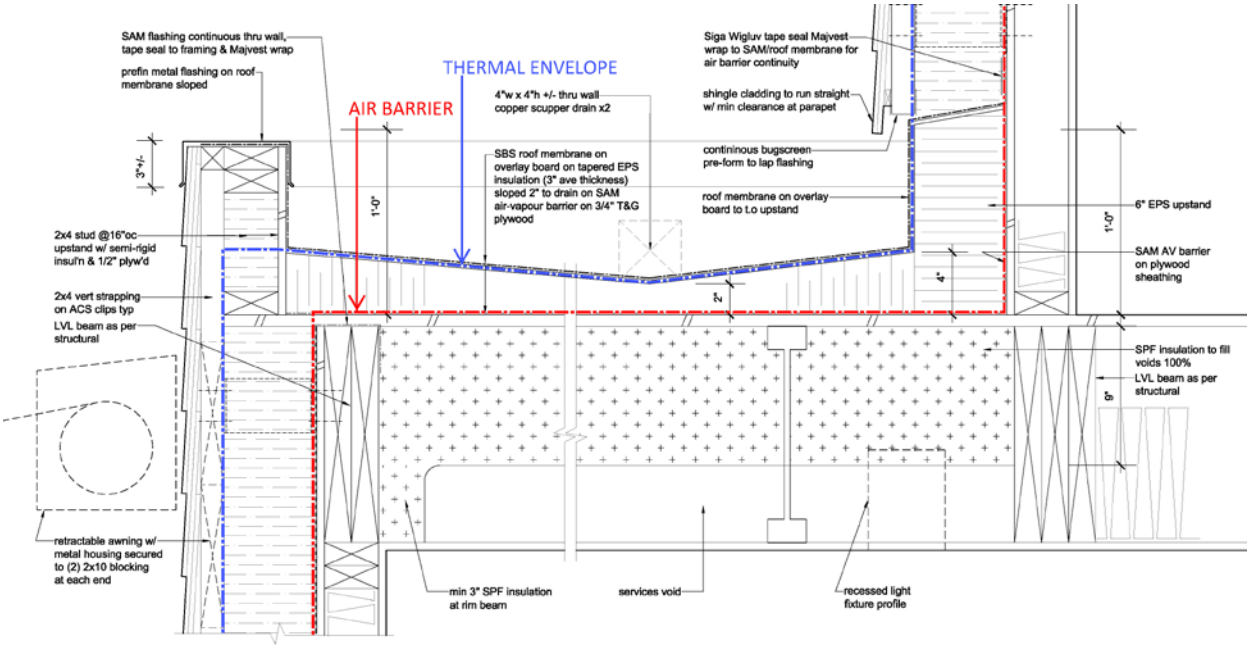
EPS Insulation on sand bedding & compacted fill under basement floor slab



1/A6 FRAME WALL SECTION DETAILS 3"=1'-0"

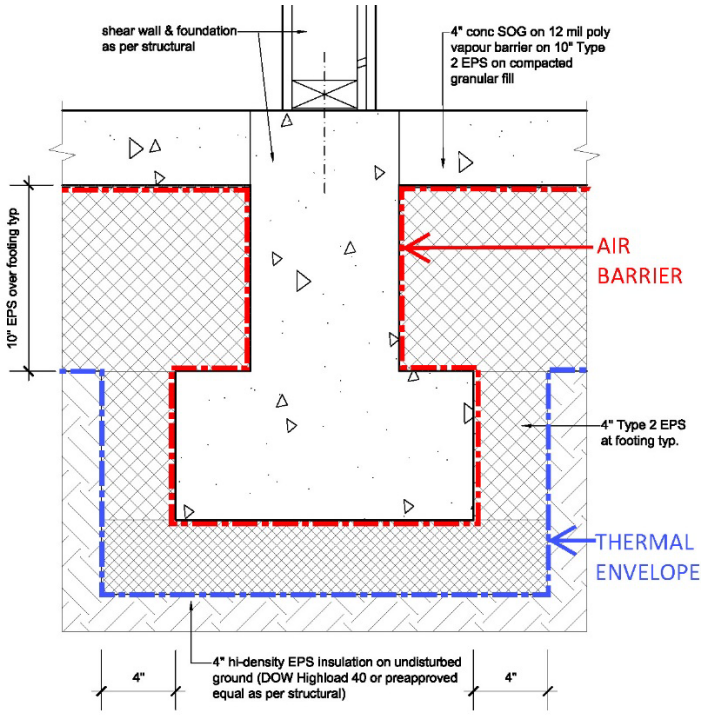


2/A6 ICF WALL SECTION DETAILS 3"=1'-0"



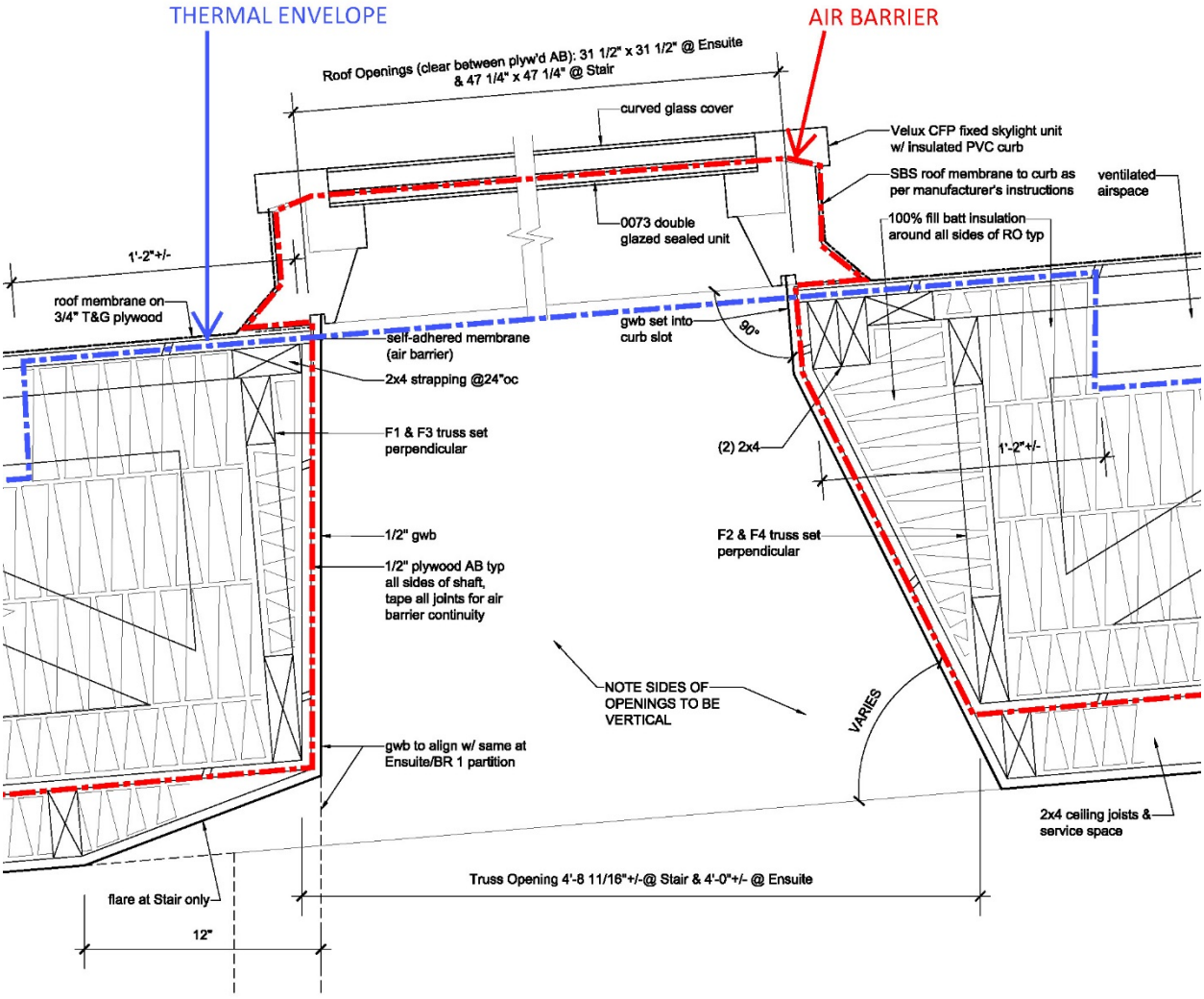
LOW SLOPE ROOF DETAIL OVER LIVING ROOM

Note spray foam polyurethane insulation between joists to eliminate need for ventilation above



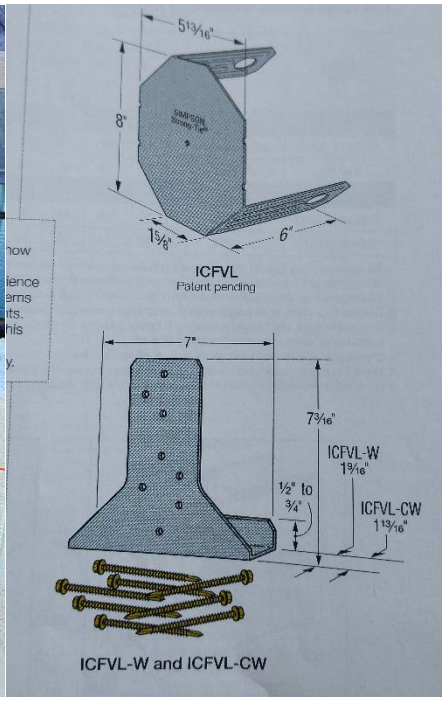
INTERIOR SHEAR WALL FOUNDATION

Note full insulation wrap below footing



SKYLIGHT INSTALLATION DETAIL

Prefab insulated PVC frame units allowed for simple installation of roof membrane. Units feature double glazed IGUs plus outer curved glass cover.



ICF wall corner detail Simpson ICFVL cut sheet

Note Simpson ICFVL ledger connectors were required for structural reasons at junction of ICF walls and main level framing. Thermal bridging was reduced by in-floor insulation along inside face of LVL ledger.

ICF basement walls which are underground except for ambient assembly facing stair-lightwell on right. Concrete retaining wall returns do not penetrate EPS outer layer.

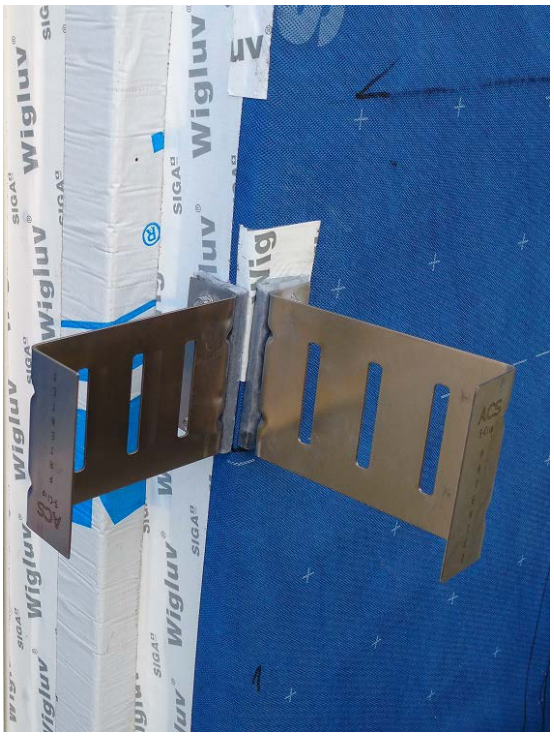
Interior shear wall foundation. Note rigid insulation below and each side of concrete footing.

Main floor-ICF wall junction
Note EPS insulation filler behind LVL ledger

South wall shear frame in wall at LR opening

Typical prefabricated exterior wall wood frame panels

Upper level sloped roof trusses. Note 38x89 cross strapping for roof ventilation.



ACS stainless steel wall ties w/ Proloft aerogel thermal break

Tie spacing 406mm oc hor & 812mm oc vertical
Note SBS waterproofing over top of ICF wall

Exterior insulation & strapping secured to ACS ties. Note wood blocking for awning attachment placed within strapping layer to eliminate thermal bridging.

Window & strapping surround in frame wall

ICF-frame wall junction with tapered XPS

Typical metal window sill & trim at frame wall

Tapered insulation at exterior door sill below stainless steel threshold

6.0 Windows, Doors & Skylights

Euroline 4700 series Thermoplus PHI certified windows & glazed doors with insulated hybrid fiberglass/uPVC frames were selected based on their proven high performance, durability and cost effectiveness. A higher solar heat gain coefficient for triple glazed units was specified for the south facing exposure. Lower SHGC & U-value glazing was selected for north, east & west elevations to reduce overheating in summer and winter heat loss.

Data below is taken from Certified PH Component certificate based on tilt and turn window test size of 1.23m x 1.48m and Cardinal IGU test data. Fixed window and glazed door performance is similar.

U-frame W/m^2K	Frame Width	Glazing	Psi-value Panel Edge W/mK	U-glazing W/m^2K	SHGC	Visible Light Transmission	U-window W/m^2K
0.79	115mm	Cardinal 4mm E180-16 argon-4mm clear-16 argon-4mm E180	0.027	0.67	0.55	0.69	0.77
0.79	115mm	Cardinal 4mm E270-16 argon-4mm clear-16 argon-4mm E180	0.027	0.64	0.33	0.61	0.75

Two Velux CFP Curve Tech fixed skylights with double glazed IGUs plus outer glass cover and insulated PVC frames were used at upper level. U-frame = 0.75 W/m^2K, U-glass = 1.05 W/m^2K and SHGC = 0.45.

7.0 Airtightness

Air barrier is provided by different materials according to location:

Lower level floor:	12mm polyethylene sheet below concrete slab with taped joints
Lower level ICF walls:	Nudura self-adhered membrane (SAM) over exterior EPS insulation
Exterior wood frame walls:	Siga Majvest vapour permeable weather barrier with Siga taped joints over plywood sheathing
Upper level sloped roof:	Plywood with taped joints at underside of wood trusses
Upper level floor over garage:	Plywood with taped joints at underside of engineered wood joists
Main level roof over LR:	Self-adhered membrane (SAM) over plywood sheathing

Air barrier continuity between dissimilar materials and at service penetrations thru thermal envelope is achieved by the use of Siga taped joints and caulking sealants at electrical cable penetrations only. Vapour retardant paint is used on all interior gypsum board surfaces at thermal envelope.

Final Blower Door Test yielded a result of 0.41 ACH at 50Pa as follows:

Building & Blower Door Test Information	
Testing Agent	Adapt Energy Advising
Testing Standard	ISO 9972 (EN 13829)
Test Mode	Pressurization and Depressurization
Test Date	October 27, 2020
Building Air Volume Vn50	574m^3
Treated Floor Area (TFA)	202.83m^2
Thermal Envelope Area	684.98m^2
Building Elevation	10m
Building Height above grade	10m

Blower Door Test Results	
Air Changes at 50 Pa, n_{50} (/h)	0.41
Air Leakage Rate at 50 Pa, q_{50} (m^3/h)	233.05
Specific Leakage Rate (Envelope) at 50 Pa, qE_{50} ($m^3/h/m^2$)	0.430
Specific Leakage Rate (Floor) at 50 Pa, qF_{50} ($m^3/h/m^2$)	1.149
Effective Leakage Area at 50 Pa, $EfLA_{50}$ (m^2)	0.00710
Specific Effective Leakage Area (Envelope) at 50 Pa, ELA_{E50} (cm2/m2)	0.104
Specific Effective Leakage Area (Floor) at 50 Pa, ELA_{E50} (cm2/m2)	0.350
Equivalent Leakage Area (cm^2)	116.5

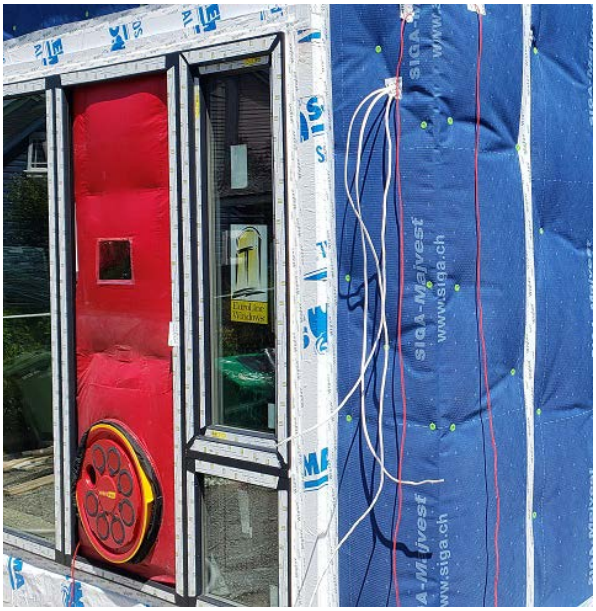
Upper level roof plywood air barrier with taped joints at underside of wood trusses. Note self-adhered membrane flashing transition to exterior Siga Majvest over top wall plate. Note 2x4 ceiling framing being installed at rear for insulated cavity to house electrical services & HRV ducts below plywood.

Typical plumbing vent penetration tape sealed

Exterior wall to service cavity framing. Note spray foam insulation used to fill framing gaps & voids.

Poly sheet air-vapour barrier under concrete slab with additional EPS thermal break at slab edge

Siga Majvest air barrier with Wigluv taped joints

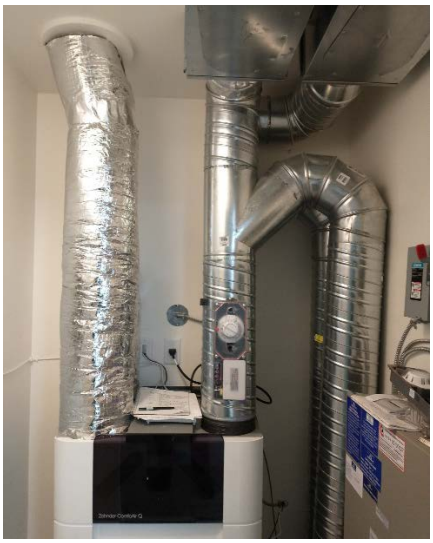


Initial Blower Door Test 05-28-2020
Siga Majvest taped to window frames & SAM

Self-adhered membrane (SAM) air barrier at ICF to wood frame wall transition

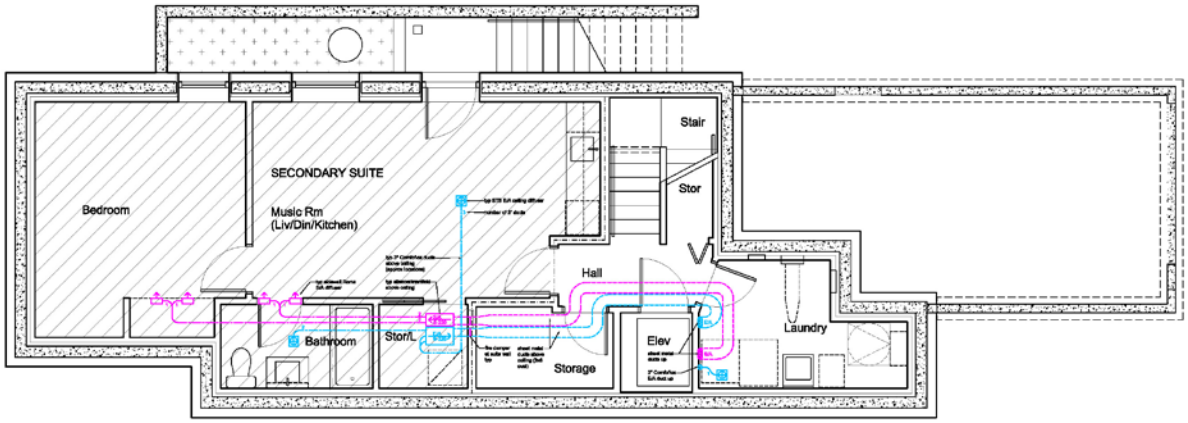
8.0 Ventilation

Balanced ventilation is provided by a Zehnder Q600 HRV located at upper level with exterior wall intake and roof exhaust terminations. HRV specific power input is 0.24 Wh/m^3 as per PHPP. Sheet metal ducts with smoke detectors serve lower level suite to meet Building Code and typical room distribution is achieved using 3" ComfoFlex ducts (magenta=supply air and blue=extract air).



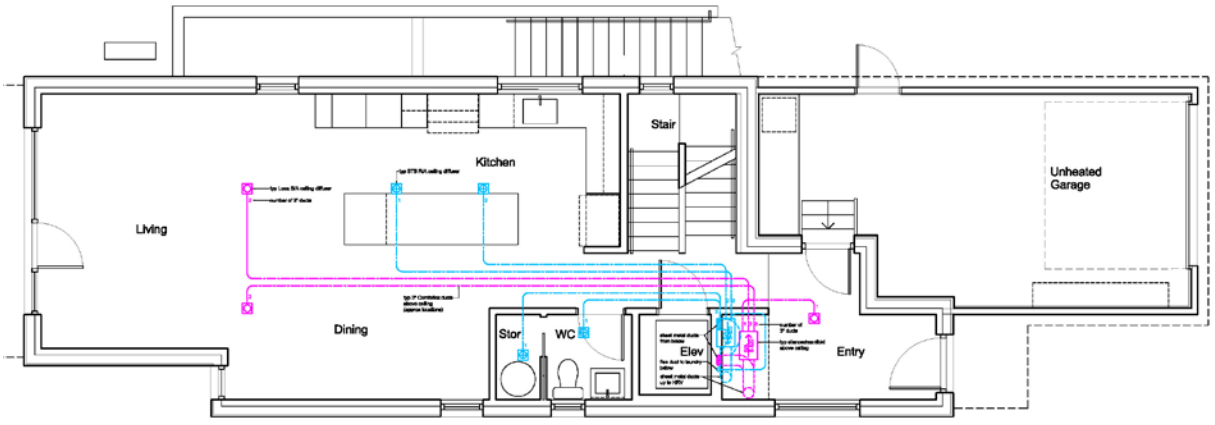
Zehnder Q600 HRV

Zehnder manifold-silencers, sheet metal & ComfoFlex ducts

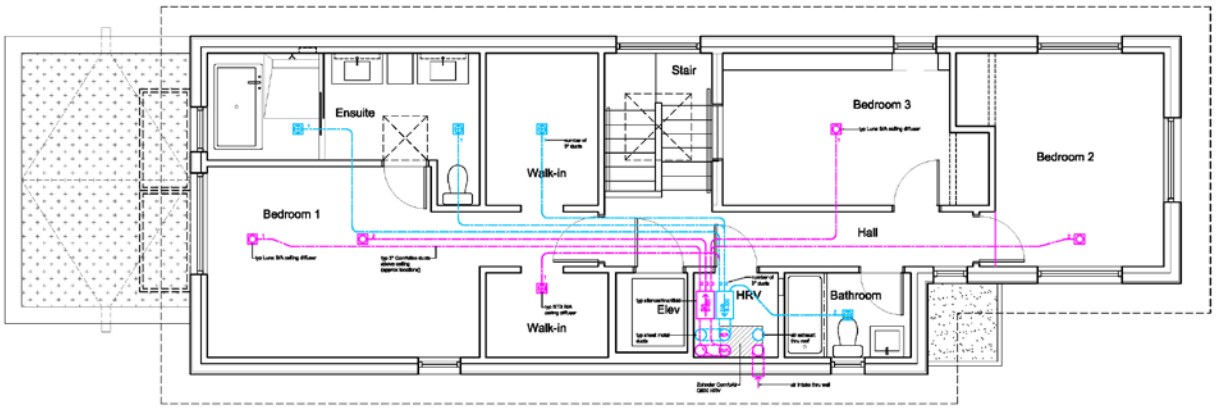


BASEMENT LEVEL VENTILATION PLAN

Supply air Extract air



MAIN LEVEL VENTILATION PLAN



UPPER LEVEL VENTILATION PLAN

9.0 Space Heating & Cooling

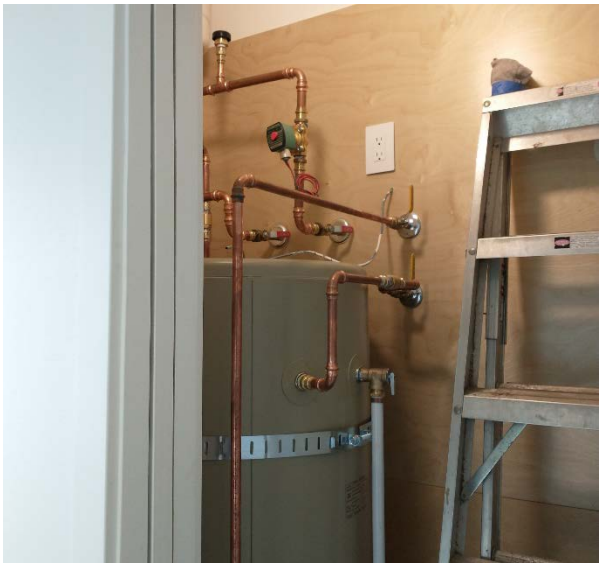
Due to low heating load and abundance of hydroelectric power produced in British Columbia, 500W electric convection wall heaters were selected for space heating, one in each of the 3 bathrooms and main floor powder room. Rough-in power for up to 3 additional heaters is provided in other rooms.

While PHPP indicates 0% overheating based on current climate data, global warming will mean increasingly hot daytime summer temperatures in Victoria. Night flush cooling by the automatic bypass feature of the Zehnder HRV should be sufficient to maintain comfort conditions on most days, supplemented by operable windows providing added cross-ventilation when needed.


Typical electric wall heater

10.0 Domestic Hot Water

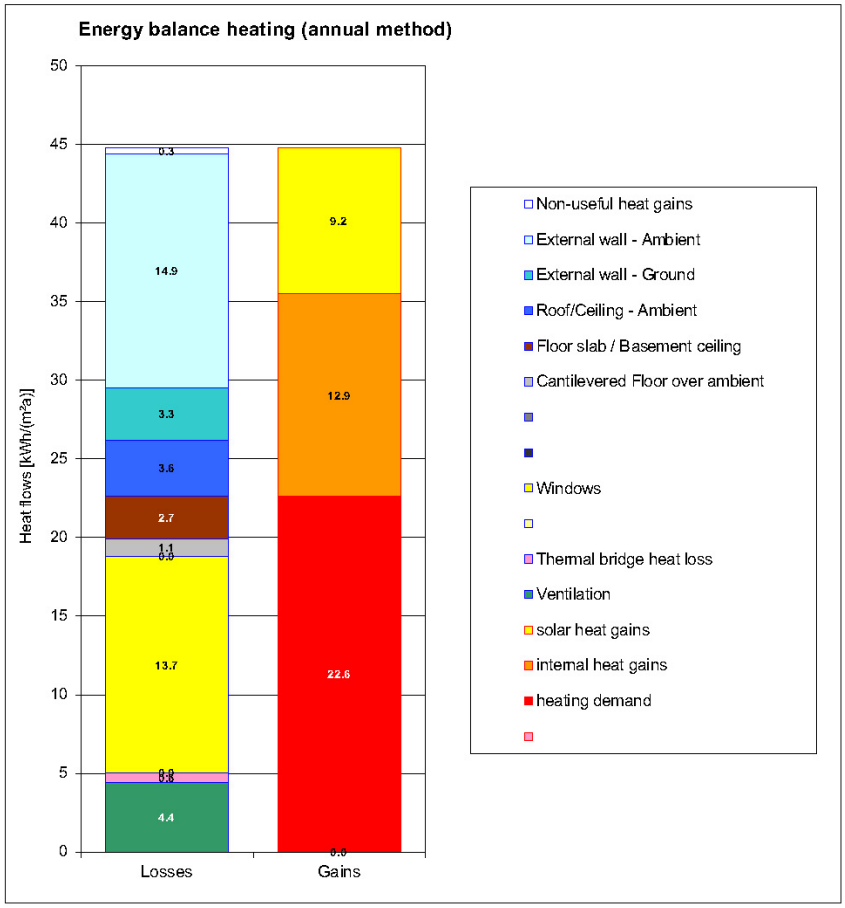
Domestic hot water is provided by an electric heat pump and stainless steel tank located at main level.



Sanden model SAN-83SSAQA DHW Tank

Sanden DHW Heat Pump model GUS-A45HPA

11.0 PHPP Final Results



PHI Low Energy Building Verification

Building:	Private Residence		
Street:			
Postcode/City:		Victoria	
Province/Country:	British Columbia	CA-Canada	
Building type:	Single Family Residence with Secondary Suite		
Climate data set:	CA0025a-Victoria		
Climate zone:	4: Warm-temperate	Altitude of location:	10 m
Home owner / Client:	Private Owner		
Street:			
Postcode/City:		Victoria	
Province/Country:	British Columbia	CA-Canada	

Architecture:	James Kerr Architect		
Street:	1423 Haultain Street		
Postcode/City:	V8R2J6	Victoria	
Province/Country:	British Columbia	CA-Canada	
Energy consultancy:	James Kerr Architect		
Street:	1423 Haultain Street		
Postcode/City:	V8R2J6	Victoria	
Province/Country:	British Columbia	CA-Canada	

Mechanical engineer:			
Street:			
Postcode/City:			
Province/Country:			
Certification:	CertiPHiers Cooperative		
Street:	539 SE 59th Court		
Postcode/City:	97215		
Province/Country:	Oregon		

Year of construction:	2020	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	2	Internal heat gains (IHG) heating case [W/m²]:	2.6	IHG cooling case [W/m²]:	2.9
No. of occupants:	4.8	Specific capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area m²	202.8				
Space heating	Heating demand kWh/(m²a)	21	≤	30	-	yes
	Heating load W/m²	12	≤	-	-	
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	-
	Cooling load W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C) %	0	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n_{50} 1/h	0.4	≤	1.0		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	122	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	62	≤	75	-	yes
	Generation of renewable energy (in relation to projected building footprint area) kWh/(m²a)	-	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

PHI Low Energy Building? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Tad	Everhart	

Certificate ID	Issued on:	City:
	20/09/21	Portland

12.0 Construction Cost

Withheld by Owner

13.0 Occupant Satisfaction

“As homeowners, we're completely satisfied with the work of James Kerr Architect and the Passive House aspects of our new home with secondary suite. He introduced us to the excellent Passive House builder, Interactive Construction, that we hired to achieve our goal of receiving PHI certification. We completed our project successfully during the challenging Covid pandemic period thanks to exceptional team skills in design and project management.

The house's strategically placed triple-glazed windows, doors and skylights bring in natural light and warmth while the thick, well-insulated walls help keep out neighborhood noise. The architectural design includes "future-proofing" features such as an elevator and wider doorways to accommodate residents and visitors of all ages and mobilities. The house's form and function make it a comfortable place to live and maintain with a constant interior temperature through the summer and winter months.”