Project Documentation
Casa Luca - Vancouver

1 Abstract / Zusammenfassung

Single Family House in Vancouver, British Columbia, Canada

1.1 Data of building / Gebäudedaten

Year of construction/ Baujahr	2015	**Space heating / Heizwärmebedarf**	**11.38 kWh/(m²a)**
U-value external wall/ U-Wert Außenwand	0.125 W/(m²K)		
U-value basement ceiling/ U-Wert Kellerdecke	0.124 W/(m²K)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	59 kWh/(m²a)
U-value roof/ U-Wert Dach	0.073 W/(m²K)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	44 kWh/(m²a)
U-value window/ U-Wert Fenster	0.78 W/(m²K)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	0 kWh/(m²a)
Heat recovery/ Wärmerückgewinnung	92.4 %	Pressure test n_{50} / Drucktest n_{50}	0.58 h-1
Special features/ Besonderheiten	Photovoltaic pannels		

1.2 Brief Description ...

Passive House Casa Luca

Casa Luca was a project born out of the necessity for a bigger space for a growing family. The process may have started as such, but it quickly evolved into a broader challenge of creating a housing prototype for young urban families. Could we produce an easily replicable typology for Vancouver's RS-1 zone that was beautiful, a source of inspiration and learning, yet also achievable in today's market? By employing commonly used construction approach, materials, and components that met the PH standard we were able to do so with only a small cost premium over standard construction techniques.

Casa Luca sits on the south side of an east-west street in a part of Vancouver that enjoys mountain views to the north. To achieve PH performance, one must limit glazing on north facades and give priority to solar gain from the south. A roof deck overcomes this conflict by providing those views, and at the same time, a private outdoor space away from the street.

Also, a 3kw solar system was installed [that is currently producing half of the energy that is normally required for a house this size in Vancouver]. The panels were easily added to a metal standing seam roof, but the roof itself was a challenge. In Vancouver, designing a south-facing roof on lots zoned RS-1 is problematic, because the angle of daylight setback generally supports gabels that slope eastwest. We had to get relaxation to make it work.

Further to standard PH requirements, analytical sensors were installed to test the performance of all walls and roofs for moisture content and temperature gradient. As well, the power produced by the solar panels is logged and compared to actual usage.

Casa Luca is the proof that it is possible to produce a custom-designed building that is truly energy and cost efficient while satisfying everyone's needs and dealing with Vancouver's zoning.

1.3 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Lucio Picciano DLP Architecture http://dlpdesigns.com/portfolio/items/3322/
Implementation planning/ Ausführungsplanung	Lucio Picciano DLP Architecture
Building systems/ Haustechnik	Lucio Picciano DLP Architecture
Structural engineering/ Baustatik	Jansson Structural
Building physics/ Bauphysik	Lucio Picciano DLP Architecture
Passive House project planning/ Passivhaus-Projektierung	Lucio Picciano DLP Architecture
Construction management/ Bauleitung	Lucio Picciano DLP Architecture

Certifying body/ Zertifizierungsstelle	Passiv Haus Italia Dr. Francesco Nesi	
Certification ID/ Zertifizierungs ID	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivehouse-database .org)	4515

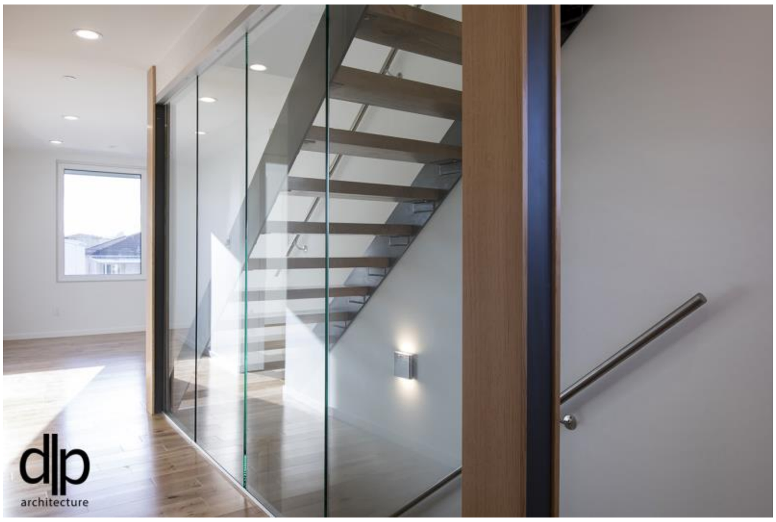
Author of project documentation / Verfasser der Gebäude-Dokumentation	Lucio Picciano DLP Architecture
Date, Signature/ Datum, Unterschrift	

2 Elevation views of the Passive House Casa Luca

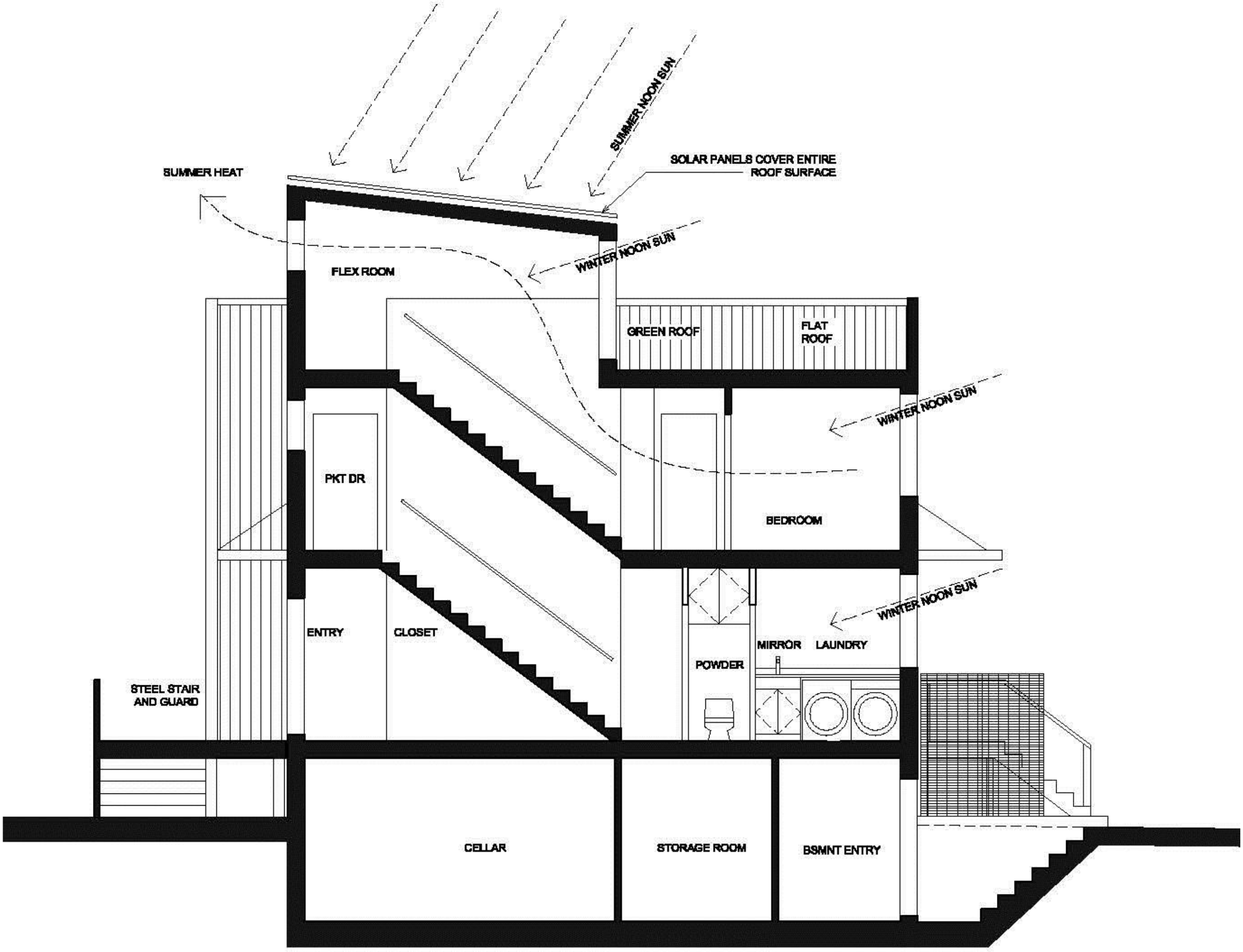
Views of the North facade

Views of the South facade

3 Exemplary photos from the inside of the house

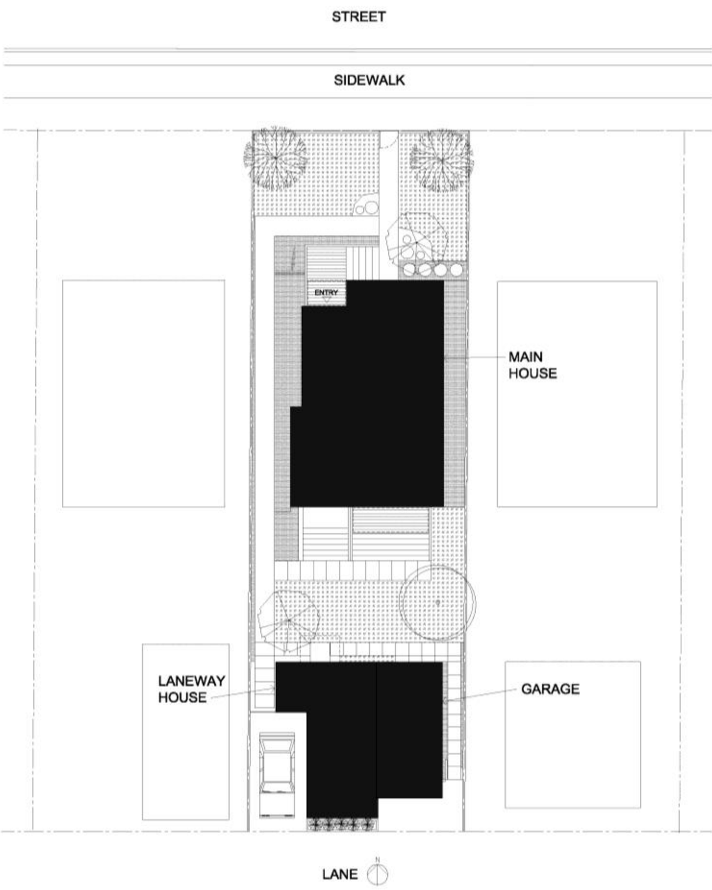


4 Section of the house



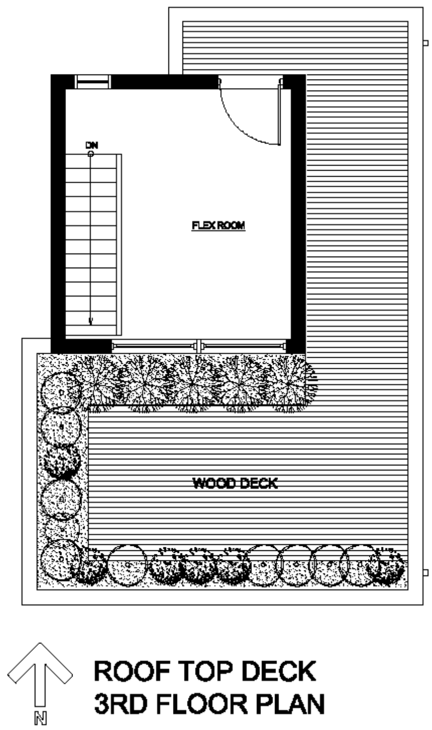
CASA LUCA PASSIVE HOUSE - SECTION LOOKING EAST

5 Floor plans



MAIN FLOOR PLAN

2ND FLOOR PLAN



ROOF TOP DECK
3RD FLOOR PLAN

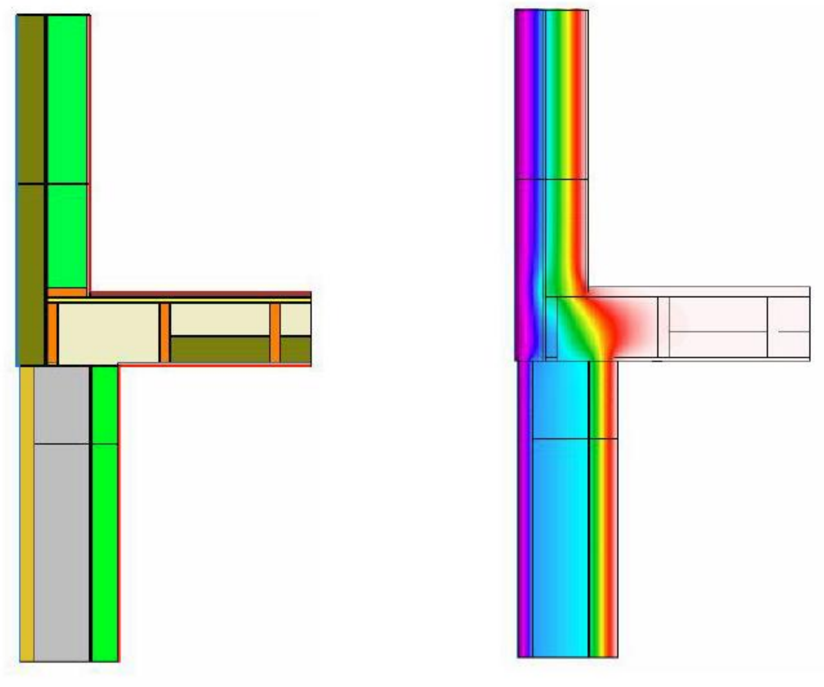
6 Contruction of floor slab / basement ceiling

The basement ceiling forms the lower portion of the thermal envelope, it has a heated unoccupied storage basement under it. This assembly is made up of TJI wood trusses spaced 24” apart, they are 9.5” deep. The joist space is filled with 7” of closed cell polyurethane foam, the remaining 2.5” is filled with mineral wool. The ceiling is then lined with 2 layers of gypsum. The upper surface has ¾” plywood, plus 3/8” plywood, plus ½” ceramic tile floor.

Basement ceiling framing

Basement ceiling insulation

Basement exterior insulation



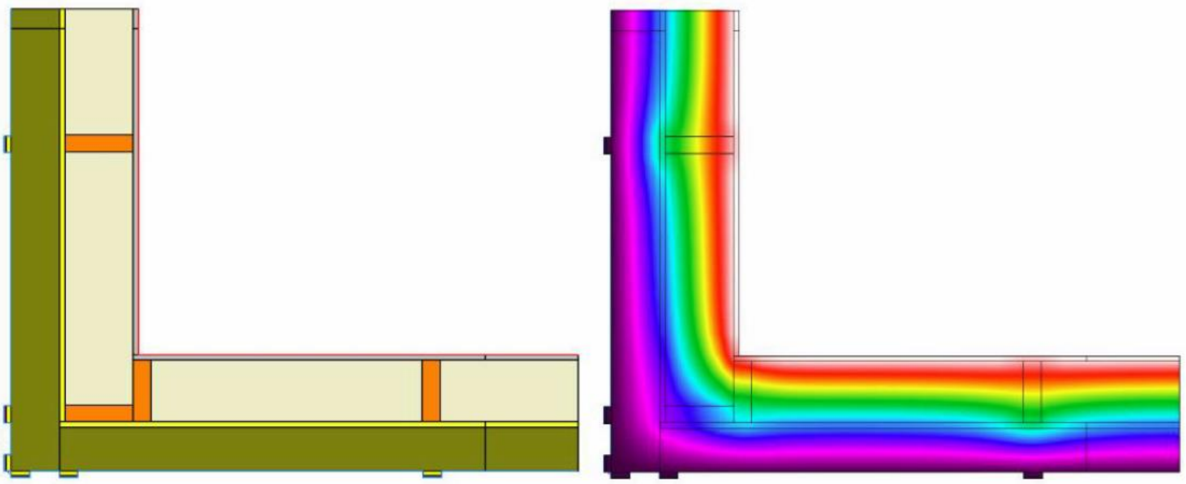
Thermal Bridge Calculation: PSI Value = -0.04

7 Contruction of the exterior walls

The main exterior walls are 2x6 wood frame spaced 24" apart. The stud space is filled with closed cell polyurethane foam. The entire exterior of the wall over the plywood is covered with 4" of mineral wool medium density screw on with only 4 screws. All framing gaps and connections are sealed with siga wigluv or corvum at interior.

All exterior walls foam and tape

All exterior walls mineral wool



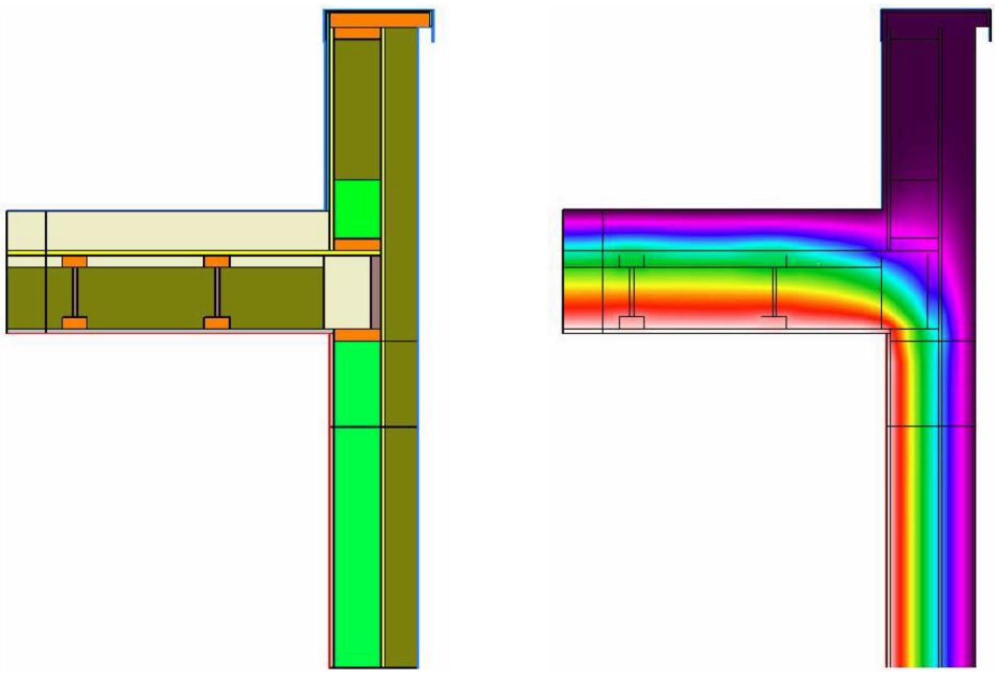
Exterior wall corner Thernal Bridge Calculation, Psi value = -0.025

8 Contruction of the roof

The top floor roof is a low slope assembly also made of TJI wood joists that are 9.5” deep. The entire space is filled with 9.5” open cell polyurethane foam, above the plywood, the entire roof has 4” of isoboard (polyisocyanurate) connected to the mineral wool of the adjacent walls. This completes the wrapping of the entire building in insulation to create a thermal bridge free form.

The top floor roof deck is built up of TJI similar to above but framed flat. The joist spaces are filled with 3” of closed cell polyurethane insulation then filled with 6” of mineral wool. Above the plywood there is 6” of isoboard then the roof membrane.

Top roof insulation under metal



Parapet corner Thermal Bridge Calculation, Psi value = -0.023

Roof insulation (foam)

Roof insulation (isoboard)

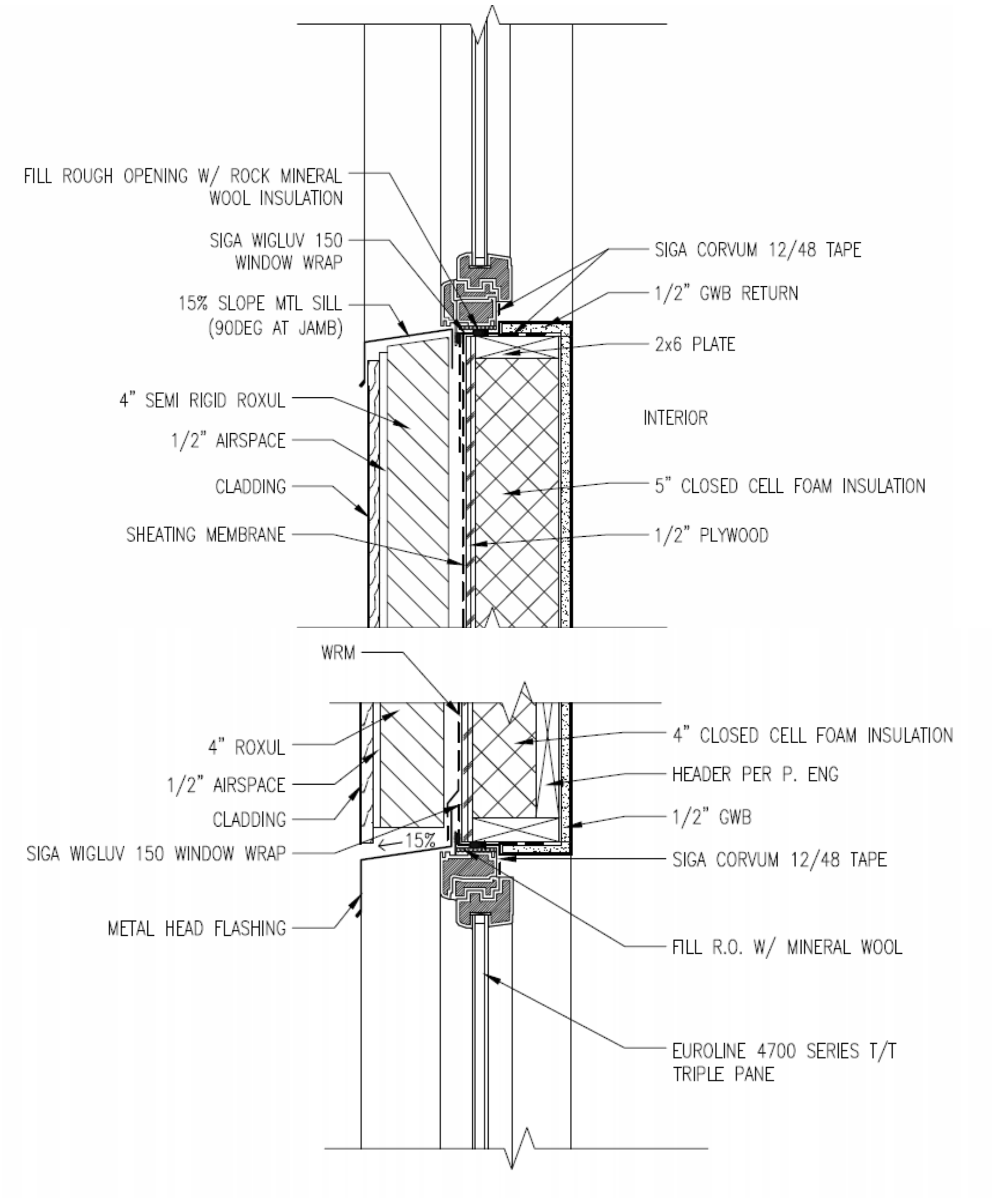
Roof deck insualtion thickness

Roof insulation (foam and mineral wool

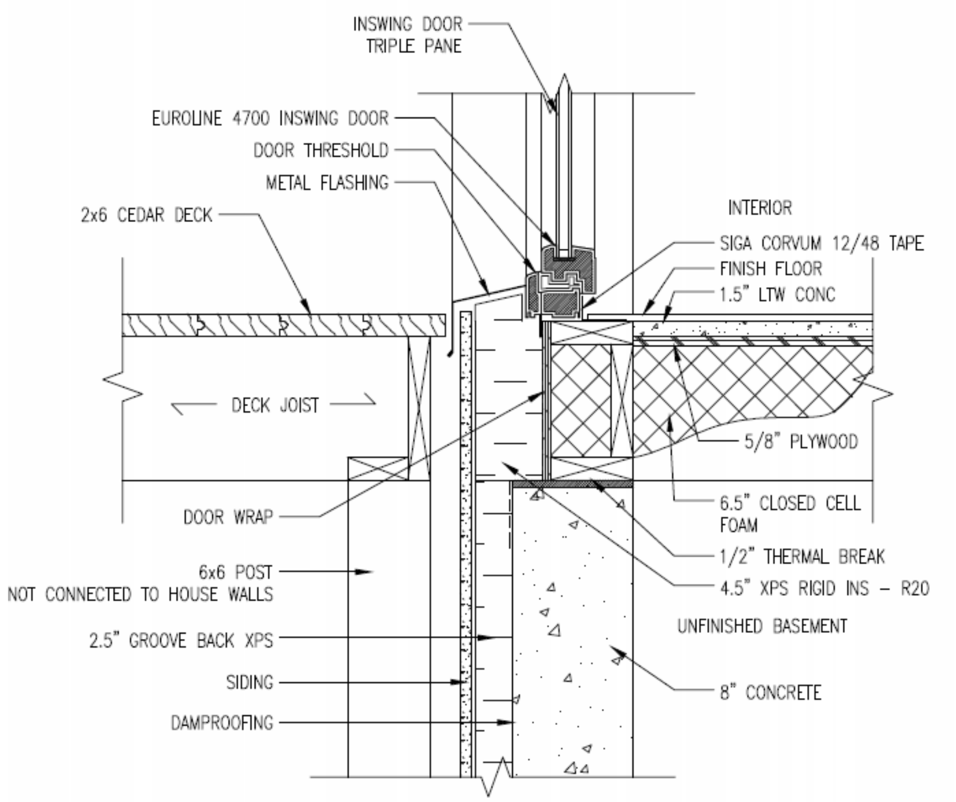
9 Windows and installation of the windows

All windows and doors are Euroline b4700 series certified passive house with cardinal triple glazing. The frame u-values are 0.77 for tilt and turn, 0.75 for fixed frame, and 0.78 for doors.

The windows were installed at midwall with a nail flange over the plywood wall sheathing. The nail flange is then entirely taped to the sheathing membrane with SIGA Wigluv. The interior frames gap is filled with mineral wool thEn taped with SIGA corvum all 4 sides to the adjacent wood framing. All framing gaps sealed with tape. There is no interior vapour barrier membrane as the sprayfoam creates a monolithic assembly, not required.



Window sill and header detail



Door sill detail

Window seal exterior

Window seal interior

4700 Series ThermoPlus Thermal Performance Chart

Tilt and Turn Window

U Frame (U_f W/m^2-K	Frame Height mm	Ψ (psi) W/m-K	Glass	U Value COG W/m^2-K	Solar Factor (g) COG
0.77	115	0.033	4 180-16 argon-4 Clear-16 argon-4 180	0.63	0.55

Picture Window

U Frame (U_f W/m^2-K	Frame Height mm	Ψ (psi) W/m-K	Glass	U Value COG W/m^2-K	Solar Factor (g) COG
0.75	72	0.033	4 180-16 argon-4 Clear-16 argon-4 180	0.63	0.55

Door

U Frame (U_f W/m^2-K	Frame Height mm	Ψ (psi) W/m-K	Glass	U Value COG W/m^2-K	Solar Factor (g) COG
0.78	142	0.033	4 180-16 argon-4 Clear-16 argon-4 180	0.63	0.55

Notes:

1. Frame only U value (U_f) tested according to EN 12412-2
2. Center of Glass (COG) U value and Solar factor according to EN 673 and EN 410
3. Frame and sash with EPS foam insulation
4. Cardinal glass Low E 180 4mm pane
5. With TriSeal Super Spacer 16mm thick
6. With Argon gas

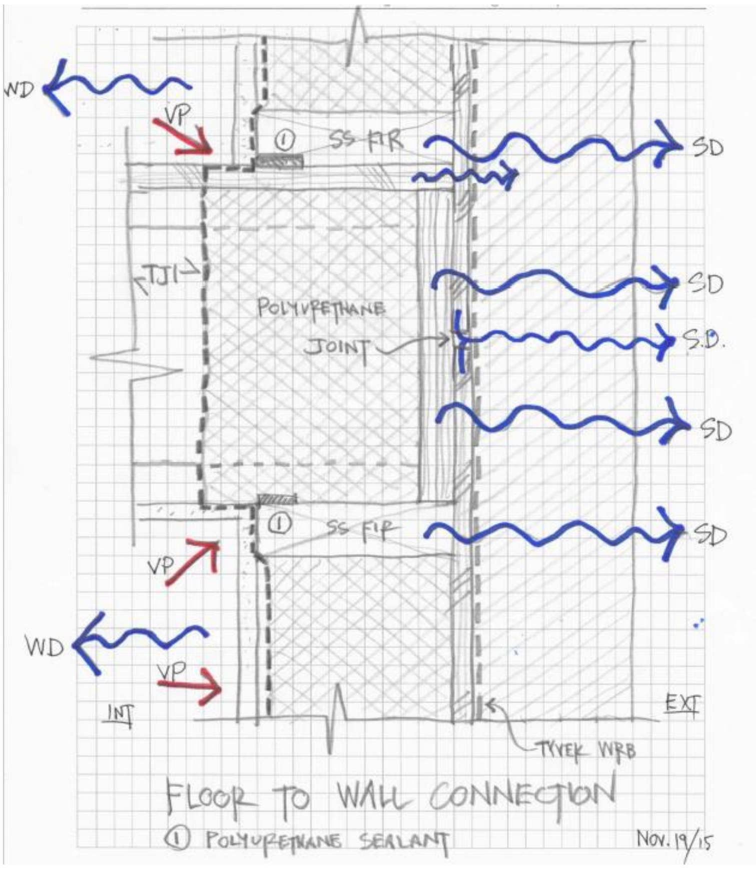
10 Airtight Building Envelope

How did we achieved this level of airtightness in this house:

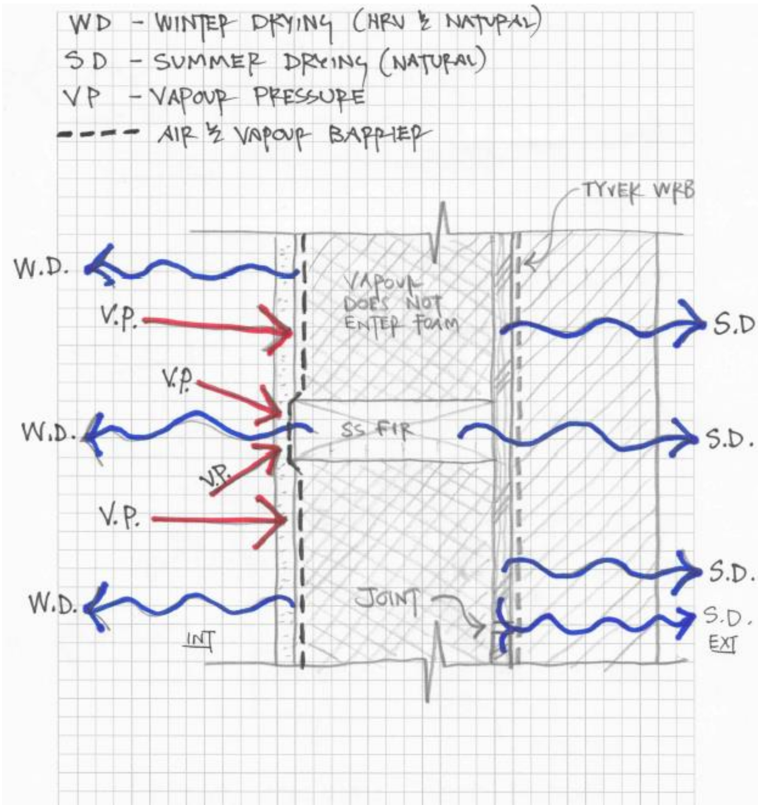
The air tightness was achieved in 2 ways.

First, the sheathing and roof membranes installed over the plywood sheathing at the exterior are completely taped, sealed and continuous. This forms the primary air tightness layer and water proofing layer. The windows, doors and penetrations are all sealed to this layer at the outside.

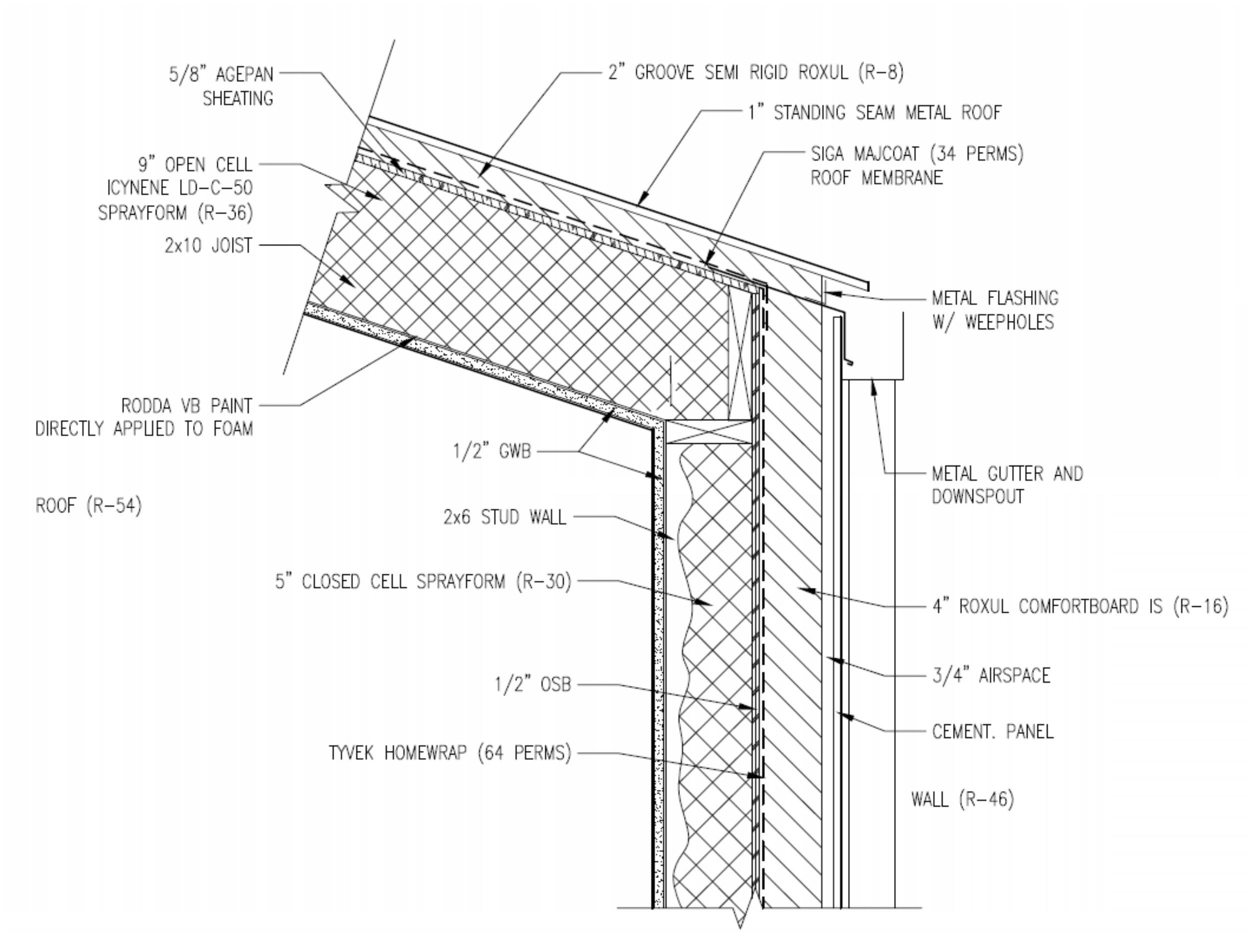
Second, the entire thermal envelope of wood is sprayed with polyurethane foam creating an monolithic assembly. Any gaps in framing and all windows, doors and penetrations are sealed to the wood with SIGA tape.



Wall to floor air barrier concept



Wall air barrier concept



Shed roof eave detail

Roof membrane to wall

Parapet membrane to roof

The pressure test was carried out on the 2015-08-16 by Monte Paulsen.

Summary

retrotec **FanTestic**	version: **5.8.13**	licensed to: **Red Door Energy Design Ltd**
Test date: **2015-08-16**	By: **Monte Paulsen**	
Customer:	**Lucio Picciano** **DLP ARchitecture** **806 - 318 Homer St** **Vancouver BC** **(all measurements from PHPP)**	
Building Lot Number:		
Building address:	**3322 Adanac** **Vancouver, BC** **Canada**	

Building and Test Information	
Test file name:	**CasaLuca_EN13829AirtightnessData-16aug2015**
Building volume:	**354.5**
Building Height (from ground to top):	**10**
Floor Area:	**165.7**
Envelope Area:	**396.3**
Building Exposure to wind	**Partially protected building**
Accuracy of measurements	**1%**

Results	
Air flow at 50 Pa, V_{50} [m³/h]	**206.5**
Air changes at 50 Pa, n_{50} [/h]	**0.58**
Permeability at 50 Pa, q_{50} [m³/h/m²]	**0.520**
Specific leakage at 50 Pa, w_{50} [m³/h/m²]	**1.245**
Effective leakage area at 50 Pa, A_L [cm²]	**62.85**
Equivalent leakage area at 50 Pa, A_L [cm²]	**103.1**
Normalized Leakage Area [cm²/m²]:	**0.159**

Photo of the equipment installation

11 Ventilation Unit

In order to greatly reduce the ventilation losses, a balanced supply air/extract system with a highly efficient counterflow air-to-air heat exchanger was used.

The product type is Paul Novus 300 HRV. The Zehnder Novus (F) 300 comfort ventilation device was specially developed for use in demanding residential and commercial buildings. It combines maximum comfort, simple operation and high efficiency with flexible integration in building services. The Zehnder Novus (F) 300 ventilation device moves up to 177 cfm of air at an external pressure of 0.8 "wc.

Supply/extract fans are maintenance-free 230 VAC radial fans with integrated power supply and electronic switching. The fans run at a constant volume flow to keep the air volume constant at any selected fan speed. The air volume is not affected even if the filters become soiled. Supply air and extract air settings can be made separately for each fan level in increments of 1% from 29 - 177 cfm.

Low power consumption thanks to the high energy efficiency of the ventilation unit (0.23 Wh/m³)

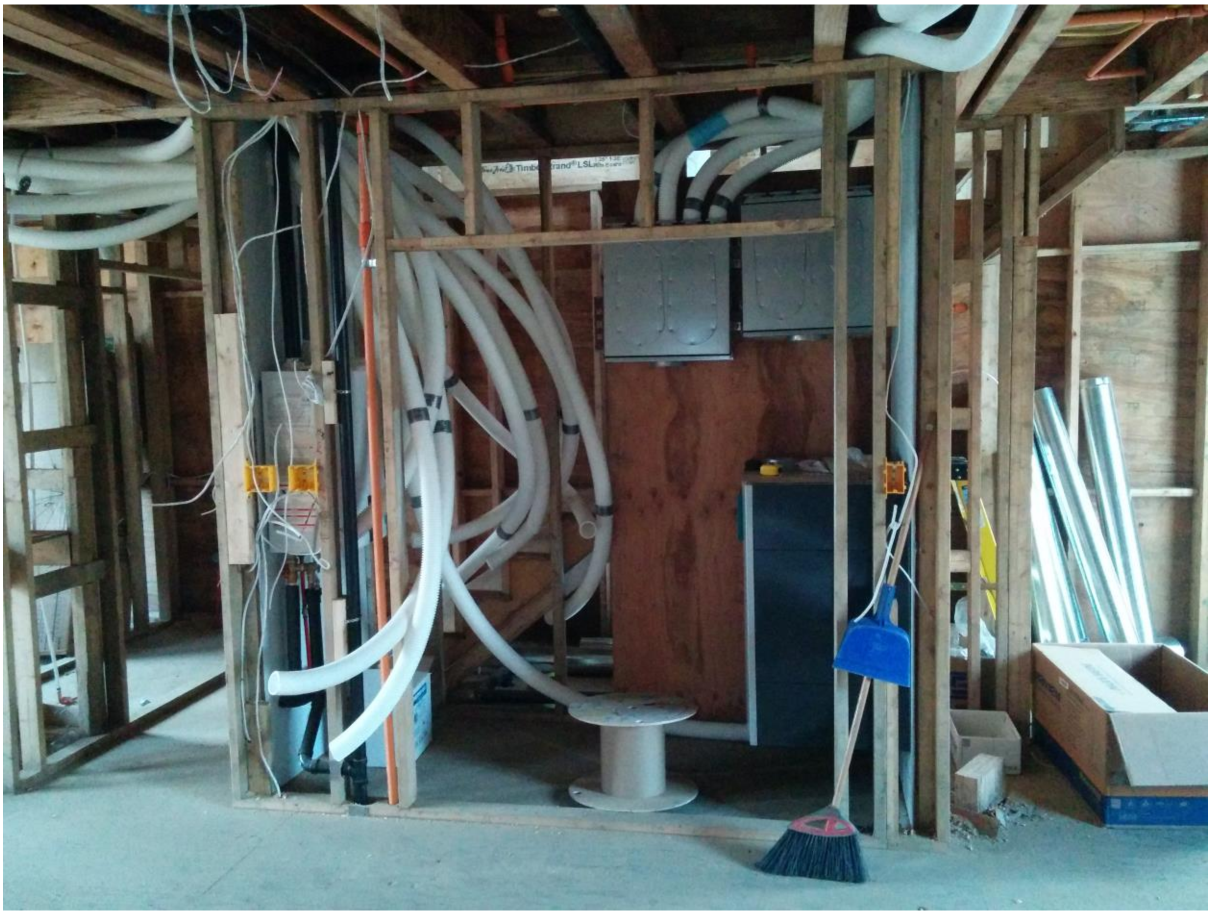
Low noise level (21 dB(A) 3 m away from the unit)

A heat recovery rate of over 92.4 % was measured with operation of this device.

All supply and exhaust ducts are either sprayed with 4” of closed cell foam or lines with 50mm of batt insulation.

HRV final insulation (only 2m)

HRV supply and exhaust insulated



Mechanical room

12 Heat Supply

The entire house is heated with a 2kw post heater attached to the HRV supply pipe.

13 PHPP Results

Passivhaus-Nachweis

Objekt:	Casa Luca		
Straße:	3322 Adanac St.		
PLZ/Ort:	V5K 2P3	Vancouver	
Provinz/Land:	British Columbia	CA-Kanada	
Objekt-Typ:	Single family Detached		
Klimadatensatz:	ud—03-CA0003c-Vancouver		
Klimazone:	4: Warm-gemäßigt	Standorthöhe:	30 m
Bauherrschaft:	Lucio Picciano		
Straße:	3322 Adanac St.		
PLZ/Ort:	V5K 2P3	Vancouver	
Provinz/Land:	British Columbia	CA-Kanada	

Architektur:	DLP Architecture Inc		Haustechnik:	DLP Architecture Inc	
Straße:	#806 318 Homer St.		Straße:	#806 318 Homer St.	
PLZ/Ort:	V6B 2V2	Vancouver BC	PLZ/Ort:	V6B 2V2	Vancouver
Provinz/Land:	British Columbia	CA-Kanada	Provinz/Land:	British Columbia	CA-Kanada
Energieberatung:	Red Door Energy.		Zertfizierung:	ZEPHIR - Passivhaus Italia	
Straße:	201 – 1001 Kingsway		Straße:	Loc. Fratte 18/3	
PLZ/Ort:	V5V 3C7	Vancouver	PLZ/Ort:	38057	Pergine Valsugana (TN)
Provinz/Land:	British Columbia	CA-Kanada	Provinz/Land:	Trentino-Alto Adige	IT-Italia

Baujahr:	2015	Innentemperatur Winter [°C]:	20.0	Innentemp. Sommer [°C]:	25.0
Zahl WE:	1	Interne Wärmequellen (IWQ) Heizfall [W/m²]:	2.5	IWQ Kühlfall [W/m²]:	2.5
Personenzahl:	2.8	spez. Kapazität [Wh/K pro m² EBF]:	60	Mechanische Kühlung:	

Gebäudekennwerte mit Bezug auf Energiebezugsfläche und Jahr

				Kriterien	alternative Kriterien	Erfüllt?[2]
	Energiebezugsfläche m²	132.8				
Heizen	Heizwärmebedarf kWh/(m²a)	11	≤	15	-	ja
	Heizlast W/m²	10	≤	-	10	
Kühlen	Kühl- + Entfeuchtungsbedarf kWh/(m²a)	-	≤	-	-	-
	Kühllast W/m²	-	≤	-	-	
	Übertemperaturhäufigkeit (> 25 °C) %	0	≤	10		ja
	Häufigkeit überhöhter Feuchte (> 12 g/kg) %	0	≤	20		ja
Luftdichtheit	Drucktest-Luftwechsel n_{50} 1/h	0.6	≤	0.6		ja
Nicht erneuerbare Primärenergie (PE)	PE-Bedarf kWh/(m²a)	91	≤	-		-
Erneuerbare Primärenergie (PER)	PER-Bedarf kWh/(m²a)	59	≤	60	60	ja
	Erzeugung erneuerb. Energie (Bezug auf überbaute Fläche) kWh/(m²a)	44	≥	-	-	

[2] leeres Feld: Daten fehlen; '-': keine Anforderung

Ich bestätige, dass die hier angegebenen Werte nach dem Verfahren PHPP auf Basis der Kennwerte des Gebäudes ermittelt wurden. Die Berechnungen mit dem PHPP liegen diesem Nachweis bei.

Passivhaus Classic? **ja**

Funktion	Vorname	Nachname	Unterschrift
2-Zertifizierer	Francesco	Nesi	

Zertifikats-ID	Ausgestellt am	Ort
12588_ZEPHI_PH_20151228_FN	28/12/15	Pergine Valsugana (TN)

ZEPHIR S.R.L. Centro Comm. "Ponte Regio" Loc. Fratte, 18/3 - 38057 Pergine V. (TN) Partita IVA 0 2 2 2 9 6 3 0 2 2 9

PHPP Version 8.4

We 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 application.

Name:	Lucio	Registration number PHPP:	MIPCA_110913_73417057_EN8
Surname:	Picciano	Issued on:	04/09/2013
Company:	DLP Architecture Inc	Signature:	

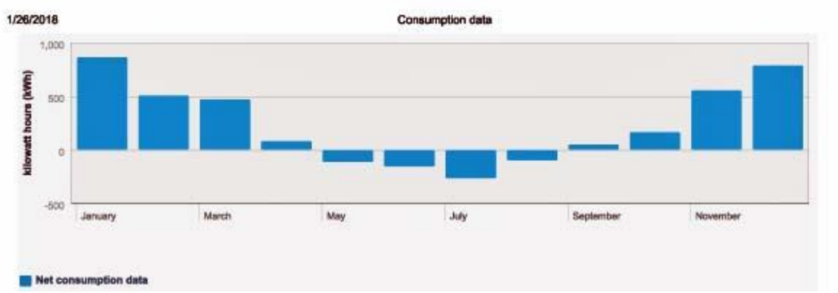
14 Construction Costs

The house was designed and built by Lucio Picciano of DLP Architecture in 2015, it took approximately 1 year to build. The total hard construction costs was $425,000 CDN

15 Measured results of the inhabited Passive House

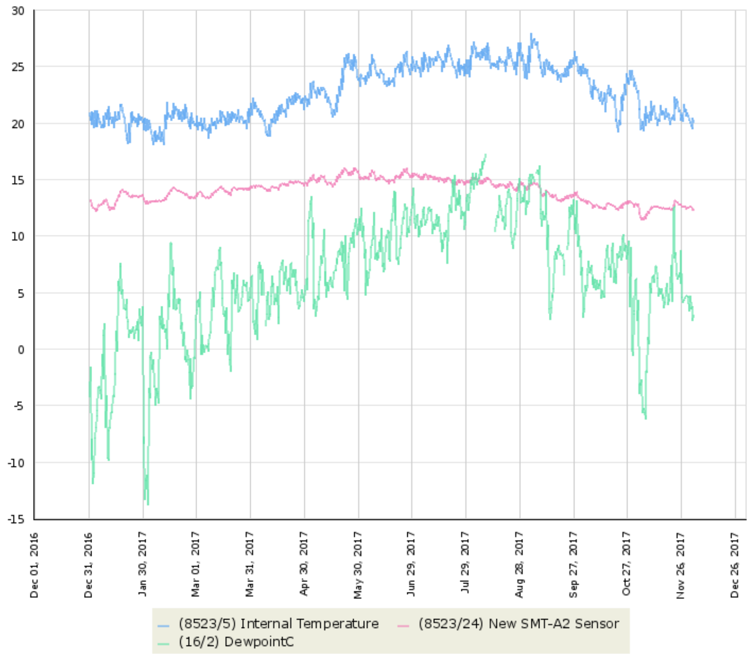
The performance has been monitored continously in order to obtain accurate feeback.

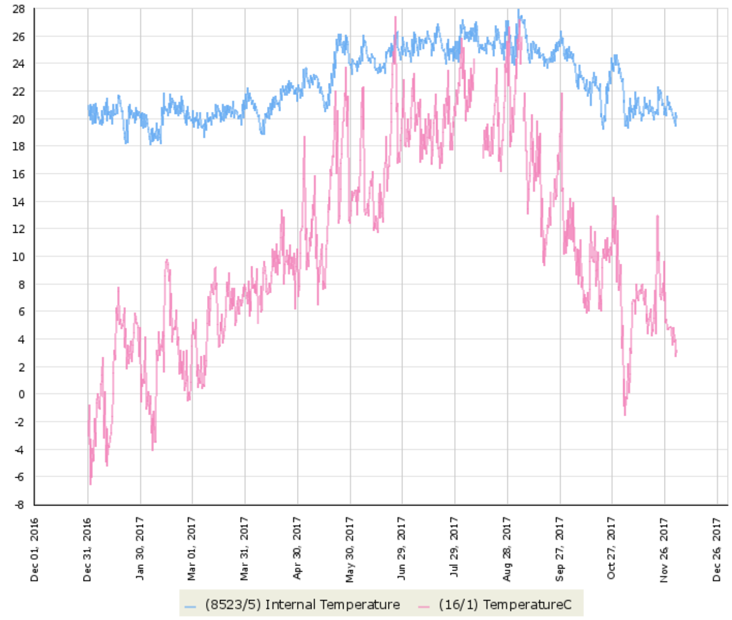
Lucio Picciano has lived in the home with his family for 3 years. The heat load and over heating frequency are very close to what the PHPP estimated. The 3kw solar array produces over 3000kwh per year which supplies about half of our total yearly consumption. The interior air quality and comfort is exceptional. The use of exterior solar shades allows us to control overheating and negated the use of any air conditioning.



Consumption data in 2017

Thermography of the house





Evolution of the temperatures in 2017

16 Publications

- **Ecohouse Canada Fall 2015**
- **Design Quqterly, Summer 2017**

PASSIVE HOUSE DESIGN:

AN ARCHITECT'S PERSPECTIVE

Too often we equate energy efficiency with sustainability, overlooking considerations of form and design. I was interested to explore how a structure designed to meet the rigorous standards of PH modelling might differ from any other.

BY LUCIO PICCIANO

The answer becomes clearer as one closely models a building for passive solar gain, ventilation, area/volume ratio, and thermal bridging. These considerations become the drivers of building orientation, massing, fenestration and envelope design.

As an architect who has always had a deep interest in elegant contextually-appropriate design combined with energy efficiency and ethical building practices, I wanted to answer this question as definitively as possible.

Casa Luca was my first attempt at not just speculating about the relationship between energy efficiency and context, but actually calculating it scientifically. Herein lies the major difference between the PH approach and most other sustainability models. PH modelling requires rigorous and exact dimensioning of all relevant details, components, and systems within a building. These aspects are then scientifically combined and calculated to show actual performance based on your design, precise geographic location and orientation.

Some constraints on design are generic for all PH projects. Working through the PH methodology, it quickly becomes apparent how adding a certain window here, or there, affects all aspects of performance. Similarly, we soon see how it may be difficult to provide overhangs and at the same time reduce thermal bridging.

Other factors may be site specific. Casa Luca sits on the south side of an east-west street in a part of Vancouver that enjoys mountain views to the north. To achieve PH performance, one must limit glazing on north facades and give priority to solar gain from the south. A roof deck overcomes this conflict by providing those views, and at the same time, a private outdoor space away from the street.

Also, we wanted to install a 3kw solar system [that is currently producing more energy than is normally required for a house this size in Vancouver]. The panels were easily added to a metal standing seam roof, but the roof itself was a challenge. In Vancouver, designing a south-facing roof on lots zoned RS-1 is problematic, because the angle of daylight setback generally supports gabels that slope east-west. We had to get relaxation to make it work.

There are also programmatic questions to be answered. In our case, what is the optimal location for a child's bedroom? The kitchen? The Laundry room? Can I hang my clothes to dry in this location or do I always have to use the dryer? These are now questions that have environmental implications and for which the answers are quantifiable. Architectural excesses can clearly be seen as such.

Of course, there will always be trade-offs in design but striving for good architecture and real energy efficiency can truly make a building comprehensible. By achieving this level of understanding, design decisions can then be made in pursuit of that combination of beauty, quality and efficiency that every good architect strives for.

Casa Luca was a project borne out of the necessity for a bigger space for a growing family. In short, we needed more bedrooms! The process may have started as such, but it quickly evolved into a broader challenge of creating a housing prototype for young urban families. Could we produce an easily replicable typology for Vancouver's RS-1 zone that was beautiful, a source of inspiration and learning, yet also achievable in today's market? By employing commonly used details, materials, and components that met the PH standard we were able to do so with only a small cost premium over standard construction techniques.

Further to standard PH requirements, we installed analytical sensors to test the performance of all walls and roofs for moisture content and temperature gradient. As well, the power produced by the solar panels is logged and compared to actual usage.

Based on our experience with Casa Luca, we believe that it is possible to produce a custom-designed building that is truly energy and cost efficient while satisfying all the needs of the client. ❖

LUCIO PICCIANO ARCHITECT, AIBC LEED IS PRINCIPAL OF DLP ARCHITECTURE INC IN VANCOUVER.

ARCHITECTURAL IMPLICATIONS OF PASSIVE HOUSE DESIGN

By Lucio Picciano

SINCE THE 2010 VANCOUVER Olympics when Canada's first certified Passivhaus or Passive House was constructed, we have a seen a slow but steady rise of this approach to building.

Especially within the last two years, the Passive House approach has now entered the lexicon of the building industry. Some jurisdictions have even adopted policies and bylaws that give incentive for targeting Passive House certification. The recently approved Step Code by the B.C. government takes a similar building approach in its four levels of advanced energy efficiency. These levels are modelled around the science of Passive House that increases thermal resistance and air tightness to greatly reduce energy consumption while improving occupant comfort and reducing carbon emissions.

Further to the adoption of the Step Code, some recently Passive House certified and in-progress projects, especially in B.C., have proven that this approach to building is no longer a fringe movement supported by a few advocacy groups. The knowledge and ability required to build to the Passive certification is now easily attainable. Local manufacturers and suppliers have also enhanced their product lines to make available certain components necessary to achieve this level of energy efficiency. Some of the components, specifically windows and heat recovery ventilators, had been difficult or costly to source in the past. This is no longer the case.

The biggest challenge has been designing within zoning bylaws that do not consider building efficiency, density and livability...

Now that Passive House and the Step Code will become part of the daily lexicon of building and design in B.C., it is no longer enough to build just for energy efficiency. We now have the means, skills and products to allow us to do this economically and practically.

The focus must now shift equally to architecture and urban design. It has become apparent that energy efficient building must be thought of in equal measure with other zoning policies that affect the daily cultures of our cities and the form of our neighbourhoods. Only then can we fully realize the potential of conserving. In a way, the culture has to change along with the building standard.

For many cities in Canada, this will mean a rethinking of the density of our largely single family residential zones. As an example, the City of Vancouver has up to 70 per cent of its land area devoted to single family zoning. Even a gentle-density approach could greatly reduce potential sprawl and enhance the urban fabric. We can then optimize our neighbourhoods by promoting pedestrian oriented smaller streets and reduced setbacks. Simple planning moves can help us avoid the cultural anonymity created by the traditional suburban model. Our dependence on the automobile and television can also be reduced in neighbourhoods where people now live closer together and are encouraged to interact at the sidewalk level.

Within our firm we have realized or designed Passive House certified projects in various different bylaw zones within Vancouver. The biggest challenge has not been the sourcing of higher quality building materials or skilled trades to achieve certification. Nor has it been applying architectural style to the limited possible forms that the zoning bylaw creates. (Though this is also an important topic).

The biggest challenge has been designing within zoning bylaws that do not consider building efficiency, density and livability as the primary focus. In Casa Luca, the first certified passive house in Vancouver, and W house, the area to volume ratio that affects the efficiency of the heating demand suffers because the bylaws prevent a more compact volume. We have had to respond architecturally in order to achieve the PH standard but also add purpose to the design. With moveable and fixed exterior shading devices coordinated with the orientation of openings we can reduce or enhance the cubic forms often associated with passive design. Superfluous detailing is not required. Allowing the site and orientation of the building and openings to inform 'architectural moves' is how we achieve complexity and style in the passive house approach. Details added to simple forms show purpose and are more maintainable.


New four-storey condo

Unfortunately, density in the RS zones of Vancouver and other cities has been granted in the form of small inefficient laneway housing. This approach seeks to 'tuck away' the density to the rear lane. It increases construction cost and renders most backyards unusable. Fee simple and zero front and side-yard setbacks shift volumes to one building. The effect is lower construction costs, more energy efficient volumes, larger backyards and buildings closer to the street for active participating residents.

In our soon to be built four storey condominium, the shape of the project was almost entirely informed by the antiquated zoning bylaw. This bylaw focuses on parking, limited density and shape. To set this project apart from the investment market-saturated 'unlivable condo' we provided a family-sized condo without the costs and hassles of owning a single family property. The 2,000 sf units will target an energy efficiency to certified passive house standards and be within walking or biking distance of all important amenities of the city.

The first milestones toward an energy efficient society have been set with enhanced building codes and passive house incentives. We now must ask if our zoning bylaws are contributing or reducing the goals we are trying to achieve.

Architects, builders and now the public have shown they can rise to the challenge of an energy efficient building approach. Planners and lawmakers must now follow in our footsteps to ensure the Passive House approach can reach its maximum potential. DQ

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