334 Douglass St,
Brooklyn,
NY 11217.

Authorised by:
Passivhaus Institut
Dr. Wolfgang Feist
Rheinstr. 44/46
D-64283 Darmstadt

Certificate

Passive House Academy hereby certifies the following building as a

Quality Approved Passive House

Casa Tortuga, 3336 County Road 3, Lyndhurst, Ontario, K0E 1N0, Canada

Client: **Marilynn Wykes and Arlene Rasmussen, 3336 County Road 3, Lyndhurst, Ontario, K0E 1N0, Canada**
Architect: **Chris Straka, VERT plan.design.build, 15 Dufferin Road, Ottawa, Ontario, K1M 1W7, Canada**
Main Contractor: **Mark Raison, Crane Building Service, Box 119, Lyndhurst, Ontario, K0E 1N0, Canada**
PH Consultant: **Stephen Magneron, Homesol Building Solutions Inc., 53 Herriott Street, Suite 202-B, Perth, Ontario, K7H 1T5, Canada**

This building was designed to meet Passive House criteria as defined by the Passive House Institute. With appropriate on-site implementation, this building will have the following characteristics:

- Excellent thermal insulation and optimised connection details with respect to building physics. High thermal comfort during the summer has been considered and the heating demand or heating load will be limited to
  - ***15 kWh per m² of living area and year or 10 W/m², respectively***
- A highly airtight building envelope, which eliminates draughts and reduces the heating energy demand: The air change rate through the envelope at a 50 Pascal pressure difference, as verified in accordance with ISO 9972, is less than

0.6 air changes per hour with respect to the building's volume

- A controlled ventilation system with high quality filters, highly efficient heat recovery and low electricity consumption, ensuring excellent indoor air quality with low energy consumption
- A total primary energy demand for heating, domestic hot water, ventilation and all other electric appliances during normal use of less than

120 kWh per m² of living area and year

This certificate is to be used only in combination with the associated certification documents, which describe the exact characteristics of the building.

Passive Houses offer high comfort throughout the year and can be heated with little effort, for example, by heating the supply air. The building envelope of a Passive House is evenly warm on the inside and the internal surface temperatures hardly differ from indoor air temperatures. Due to the highly airtight envelope, draughts are eliminated during normal use. The ventilation system constantly provides fresh air of excellent quality. Heating costs in a Passive House are very low. Thanks to their low energy consumption, Passive Houses offer security against energy scarcity and future rises in energy prices. Moreover, the climate impact of Passive Houses is low as they reduce energy use, thereby resulting in the emission of comparatively low levels of carbon dioxide (CO_2) and other pollutants.

issued:
Broomhall Business Park Wicklow, March 15th, 2016

Tomás O'Leary
Director
Passive House Academy

Certificate-ID: **13215_MosArt_PH_20160315_TOL**

Certification Documentation

Specific building demands with reference to the treated floor area				use: Monthly method	
	Treated floor area	225.1	m²	Requirements	Fulfilled?*
Space heating	Annual heating demand	**15.06**	**kWh/(m²a)**	15 kWh/(m²a)	**yes**
	Heating load	**10.26**	**W/m²**	10 W/m²	**yes**
Space cooling	Overall specific space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 25 °C)	0.0	%	-	**-**
Primary Energy	Space heating and cooling, dehumidification, DHW, household electricity.	**96**	**kWh/(m²a)**	120 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	45	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**0.4**	**1/h**	0.6 1/h	**yes**

* empty field: data missing; "-": no requirement

Passive House?	**yes**

This building has been awarded the

Quality Approved Passive House

certificate by MosArt Ltd.

This certification is based solely on the design data and specifications provided to MosArt Ltd by the client for the purpose of certification. MosArt Ltd has checked and approved the building's energy balances according to these data.

This certification does not cover quality assurance of the construction work or design implementation. MosArt Ltd hereby takes no responsibility for any faults in the above.

Passive House verification

Drawing

Building:	Casa Tortuga
Street:	3336 Counrty Road 3
Postcode/City:	Lyndhurst, ON, K0E 1N0
Country:	Canada
Building Type:	Residential
Climate:	Ottawa
Home Owner(s) / Client(s):	Marilynn Wykes & Arlene Rasmussen
Street:	3336 Counrty Road 3
Postcode/City:	Lyndhurst, ON, K0E 1N0
Architect:	Vert plan.design.build
Street:	279 Crichton St
Postcode/City:	Ottawa, ON, K1M 1W3
Mechanical System:	Stuart Fix, ReNü Building Science Inc.
Street:	52 Airport Road
Postcode/City:	Edmonton, Alberta, T5G 0W7 | C. 780.554.8192 | sfix@renubuildings.com

Year of Construction:	2015	Interior Temperature:	20.0 °C
Number of Dwelling Units:	1	Internal Heat Gains:	2.1 W/m²
Enclosed Volume V_e:	751.7		
Number of Occupants:	6.4		

Specific building demands with reference to the treated floor area — use: Monthly method

				Requirements	Fulfilled?*
	Treated floor area	225.1	m²		
Space heating	Annual heating demand	**15.06**	**kWh/(m²a)**	15 kWh/(m²a)	yes
	Heating load	**10.26**	**W/m²**	10 W/m²	yes
Space cooling	Overall specific space cooling demand		**kWh/(m²a)**	-	-
	Cooling load		**W/m²**	-	-
	Frequency of overheating (> 25 °C)	0.0	%	-	-
Primary Energy	Space heating and cooling, dehumidification, DHW, household electricity.	**96**	**kWh/(m²a)**	120 kWh/(m²a)	yes
	DHW, space heating and auxiliary electricity	45	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	**0.4**	**1/h**	0.6 1/h	yes

* empty field: data missing; '-': no requirement

Passive House?	**yes**

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:	Bob
Surname:	
Company:	
Registration number PHPP:	
Issued on:	
Signature:	

Passive House verification

AREAS DETERMINATION

Building: Casa Tortuga Heating demand 15 kWh/(m²a)

Summary

Group Nr.	Area group	Temp. zone	Area	Unit	Comments		Building element overview	Average U-Value [W/(m²K)]
1	Treated Floor Area		225.05	m²	*Living area or useful area within the thermal envelope*			
2	North Windows	A	1.12	m²			North Windows	0.974
3	East Windows	A	10.05	m²			East Windows	0.771
4	South Windows	A	37.99	m²	Results are from the Windows worksheet.		South Windows	0.770
5	West Windows	A	6.00	m²			West Windows	1.086
6	Horizontal Windows	A	0.00	m²			Horizontal Windows	
7	Exterior Door	A	0.00	m²	*Please subtract area of door from respective building element*		Exterior Door	
8	Exterior Wall - Ambient	A	197.27	m²	*Window areas are subtracted from the individual areas specified in the "Windows" worksheet.*		Exterior Wall - Ambient	0.069
9	Exterior Wall - Ground	B	100.65	m²	*Temperature Zone "A" is ambient air.*		Exterior Wall - Ground	0.074
10	Roof/Ceiling - Ambient	A	165.96	m²	*Temperature zone "B" is the ground.*		Roof/Ceiling - Ambient	0.066
11	Floor slab / basement ceiling	B	152.68	m²			Floor slab / basement ceiling	0.079
12			0.00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*			
13			0.00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X		
14		X	0.00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):*	75%		
							Thermal Bridge Overview	Ψ [W/(mK)]
15	Thermal Bridges Ambient	A	0.00	m	*Units in m*		Thermal Bridges Ambient	
16	Perimeter Thermal Bridges	P	0.00	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		Perimeter Thermal Bridges	
17	Thermal Bridges Floor Slab	B	0.00	m	*Units in m*		Thermal Bridges Floor Slab	
18	Partition Wall to Neighbour	I	0.00	m²	*No heat losses, only considered for the heating load calculation.*		Partition Wall to Neighbour	
Total thermal envelope			671.71	m²			Average Therm. Envelope	0.132

Area input

Area Nr.	Building element description	Group Nr.	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User-Determined [m²]	-	User Subtraction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection of the corresponding building element assembly	Nr.	U-Value [W/(m²K)]
	Treated Floor Area	1	Treated Floor Area	1	x (		x		+	225.05	-				) =	225.1			
	North Windows	2	North Windows													1.1	From Windows sheet		0.974
	East Windows	3	East Windows													10.0	From Windows sheet		0.771
	South Windows	4	South Windows		**Please complete in Windows worksheet only!**											38.0	From Windows sheet		0.770
	West Windows	5	West Windows													6.0	From Windows sheet		1.086
	Horizontal Windows	6	Horizontal Windows													0.0	From Windows sheet		0.000
	Exterior Door	7	Exterior Door		x (		x		+		-		) -		=		U-Value Exterior Door		
1	Basement Floor Slab	11	Floor slab / basement ceiling	1	x (		x		+	152.68	-		) -	0.0	=	152.7	Basement Floor Slab	3	0.079
2	Roof Flat	10	Roof/Ceiling - Ambient	1	x (		x		+	116.31	-		) -	0.0	=	116.3		4	0.065
3	Roof Sloped	10	Roof/Ceiling - Ambient	1	x (		x		+	37.49	-		) -	0.0	=	37.5		5	0.067
4	Wall East 1	8	Exterior Wall - Ambient	1	x (		x		+	63.86	-		) -	10.0	=	53.8		1	0.069
5	Wall Ground East 1	9	Exterior Wall - Ground	1	x (		x		+	4.86	-		) -	0.0	=	4.9		2	0.074
6	Wall Ground North 1	9	Exterior Wall - Ground	1	x (		x		+	58.60	-		) -	0.0	=	58.6		2	0.074
7	Wall Ground South 1	9	Exterior Wall - Ground	1	x (		x		+	10.45	-		) -	0.0	=	10.5		2	0.074
8	Wall Ground West 1	9	Exterior Wall - Ground	1	x (		x		+	26.74	-		) -	0.0	=	26.7		2	0.074
9	Wall North 1	8	Exterior Wall - Ambient	1	x (		x		+	47.68	-		) -	1.1	=	46.6		1	0.069
10	Wall North Roof 1	10	Roof/Ceiling - Ambient	1	x (		x		+	12.16	-		) -	0.0	=	12.2		1	0.069
11	Wall South 1	8	Exterior Wall - Ambient	1	x (		x		+	58.29	-		) -	24.0	=	34.3		1	0.069
12	Wall South 2	8	Exterior Wall - Ambient	1	x (		x		+	40.60	-		) -	14.0	=	26.6		1	0.069
13	Wall West 1	8	Exterior Wall - Ambient	1	x (		x		+	21.76	-		) -	2.3	=	19.5		1	0.069
14	Wall West 2	8	Exterior Wall - Ambient	1	x (		x		+	20.23	-		) -	3.7	=	16.5		1	0.069
15					x (		x		+		-		) -	0.0	=			0	
16					x (		x		+		-		) -	0.0	=			0	
17					x (		x		+		-		) -	0.0	=			0	
18					x (		x		+		-		) -	0.0	=			0	
19					x (		x		+		-		) -	0.0	=			0	
20					x (		x		+		-		) -	0.0	=			0	
21					x (		x		+		-		) -	0.0	=			0	
22					x (		x		+		-		) -	0.0	=			0	
23					x (		x		+		-		) -	0.0	=			0	
24					x (		x		+		-		) -	0.0	=			0	
25					x (		x		+		-		) -	0.0	=			0	
26					x (		x		+		-		) -	0.0	=			0	
27					x (		x		+		-		) -	0.0	=			0	
28					x (		x		+		-		) -	0.0	=			0	
29					x (		x		+		-		) -	0.0	=			0	
30					x (		x		+		-		) -	0.0	=			0	
31					x (		x		+		-		) -	0.0	=			0	
32					x (		x		+		-		) -	0.0	=			0	
33					x (		x		+		-		) -	0.0	=			0	
34					x (		x		+		-		) -	0.0	=			0	
35					x (		x		+		-		) -	0.0	=			0	
36					x (		x		+		-		) -	0.0	=			0	
37					x (		x		+		-		) -	0.0	=			0	
38					x (		x		+		-		) -	0.0	=			0	
39					x (		x		+		-		) -	0.0	=			0	
40					x (		x		+		-		) -	0.0	=			0	
41					x (		x		+		-		) -	0.0	=			0	
42					x (		x		+		-		) -	0.0	=			0	
43					x (		x		+		-		) -	0.0	=			0	
44					x (		x		+		-		) -	0.0	=			0	
45					x (		x		+		-		) -	0.0	=			0	
46					x (		x		+		-		) -	0.0	=			0	
47					x (		x		+		-		) -	0.0	=			0	
48					x (		x		+		-		) -	0.0	=			0	
49					x (		x		+		-		) -	0.0	=			0	
50					x (		x		+		-		) -	0.0	=			0	

Aend

Passive House verification

AREAS DETERMINATION

Building: Casa Tortuga Heating demand 15 kWh/(m²a)

Summary

Group Nr.	Area group	Temp. zone	Area	Unit	Comments		Building element overview	Average U-Value [W/(m²K)]
1	Treated Floor Area		225.05	m²	*Living area or useful area within the thermal envelope*			
2	North Windows	A	1.12	m²			North Windows	0.974
3	East Windows	A	10.05	m²			East Windows	0.771
4	South Windows	A	37.99	m²	Results are from the Windows worksheet.		South Windows	0.770
5	West Windows	A	6.00	m²			West Windows	1.086
6	Horizontal Windows	A	0.00	m²			Horizontal Windows	
7	Exterior Door	A	0.00	m²	*Please subtract area of door from respective building element*		Exterior Door	
8	Exterior Wall - Ambient	A	197.27	m²	*Window areas are subtracted from the individual areas specified in the "Windows" worksheet.*		Exterior Wall - Ambient	0.069
9	Exterior Wall - Ground	B	100.65	m²	*Temperature Zone "A" is ambient air.*		Exterior Wall - Ground	0.074
10	Roof/Ceiling - Ambient	A	165.96	m²	*Temperature zone "B" is the ground.*		Roof/Ceiling - Ambient	0.066
11	Floor slab / basement ceiling	B	152.68	m²			Floor slab / basement ceiling	0.079
12			0.00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*			
13			0.00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X		
14		X	0.00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):*	75%		
							Thermal Bridge Overview	Ψ [W/(mK)]
15	Thermal Bridges Ambient	A	0.00	m	*Units in m*		Thermal Bridges Ambient	
16	Perimeter Thermal Bridges	P	0.00	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		Perimeter Thermal Bridges	
17	Thermal Bridges Floor Slab	B	0.00	m	*Units in m*		Thermal Bridges Floor Slab	
18	Partition Wall to Neighbour	I	0.00	m²	*No heat losses, only considered for the heating load calculation.*		Partition Wall to Neighbour	
Total thermal envelope			671.71	m²			Average Therm. Envelope	0.132

Thermal Bridge Inputs

No.	Thermal bridge description	Group Nr.	Assigned to group	Quantity	x (	User determined length [m]	-	Subtraction user-determined length [m]	)=	Length ℓ [m]	Input of thermal bridge heat loss coefficient W/(mK)	Ψ W/(mK)
1	not used				x (		-		) =		not used	
2					x (		-		) =			
3					x (		-		) =			
4					x (		-		) =			
5					x (		-		) =			
6					x (		-		) =			
7					x (		-		) =			
8					x (		-		) =			
9					x (		-		) =			
10					x (		-		) =			
11					x (		-		) =			
12					x (		-		) =			
13					x (		-		) =			
14					x (		-		) =			
15					x (		-		) =			
16					x (		-		) =			
17					x (		-		) =			
18					x (		-		) =			
19					x (		-		) =			
20					x (		-		) =			
21					x (		-		) =			
22					x (		-		) =			
23					x (		-		) =			
24					x (		-		) =			
25					x (		-		) =			
26					x (		-		) =			
27					x (		-		) =			
28					x (		-		) =			
29					x (		-		) =			
30					x (		-		) =			
31					x (		-		) =			
32					x (		-		) =			
33					x (		-		) =			
34					x (		-		) =			
35					x (		-		) =			
36					x (		-		) =			
37					x (		-		) =			
38					x (		-		) =			
39					x (		-		) =			
40					x (		-		) =			
41					x (		-		) =			
42					x (		-		) =			
43					x (		-		) =			
44					x (		-		) =			
45					x (		-		) =			
46					x (		-		) =			
47					x (		-		) =			
48					x (		-		) =			
49					x (		-		) =			
50					x (		-		) =			
51					x (		-		) =			
52					x (		-		) =			
53					x (		-		) =			
54					x (		-		) =			
55					x (		-		) =			
56					x (		-		) =			
57					x (		-		) =			
58					x (		-		) =			
59					x (		-		) =			
60					x (		-		) =			
61					x (		-		) =			
62					x (		-		) =			
63					x (		-		) =			
64					x (		-		) =			
65					x (		-		) =			
66					x (		-		) =			
67					x (		-		) =			
68					x (		-		) =			
69					x (		-		) =			
70					x (		-		) =			
71					x (		-		) =			
72					x (		-		) =			
73					x (		-		) =			
74					x (		-		) =			

Passive House verification

U - L I S T

Compilation of the building elements calculated in the U-Values worksheet and other construction types from databases.

	Type		
Assembly No.	Assembly description	Total thickness	U-Value
		m	W/(m²K)
1	External Wall	0.610	0.069
2	Basement Wall	0.584	0.074
3	Basement Floor Slab	0.681	0.079
4	Flat Roof	0.648	0.065
5	Sloped Roof	0.648	0.067
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Passive House verification

U-VALUES OF BUILDING ELEMENTS

Building: Casa Tortuga

Wedge shaped building element layers and still air spaces -> Secondary calculation to the right

Assembly No. 1 | Building assembly description: External Wall | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0.13 — exterior R_{se}: 0.04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Drywall	0.250					13
2.	Mineral Fbr w Studs	0.036	Internal Studs	0.130			140
3.	Polyiso	0.024					25
4.	OSB	0.130					13
5.	Cellulose w I Joists	0.042					406
6.	Fibre Board	0.050					13
7.							
8.							

Percentage of Sec. 2: 9.4% — Percentage of Sec. 3: 2.1% — Total: 61.0 cm

U-Value: 0.069 W/(m²K)

Assembly No. 2 | Building assembly description: Basement Wall | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0.13 — exterior R_{se}: 0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum	0.250					13
2.	Mineral Fbr w Studs	0.036	Internal Studs	0.130			140
3.	Polyiso	0.024					25
4.	Concrete	2.500					152
5.	EPS	0.029					254
6.							
7.							
8.							

Percentage of Sec. 2: 9.4% — Percentage of Sec. 3: — Total: 58.4 cm

U-Value: 0.074 W/(m²K)

Assembly No. 3 | Building assembly description: Basement Floor Slab | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0.17 — exterior Rse: 0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Concrete Floor	2.400					325
2.	XPS	0.029					356
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of Sec. 2: — Percentage of Sec. 3: — Total: 68.1 cm

U-Value: 0.079 W/(m²K)

Passive House verification

U-VALUES OF BUILDING ELEMENTS

Building: Casa Tortuga

Wedge shaped building element layers and still air spaces -> Secondary calculation to the right

Assembly No. 4 — Building assembly description: Flat Roof — Interior insulation?

Heat transfer resistance [m²K/W]: interior Rsi: 0.10; exterior R_{se}: 0.10

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum	0.250					13
2.	Polyiso	0.024					25
3.	Cellulose w I Joists	0.042		0.130			140
4.	Cellulose w I Joists	0.042					470
5.							
6.							
7.							
8.							

Percentage of Sec. 2: 9.4% — Percentage of Sec. 3: — Total: 64.8 cm

U-Value: 0.065 W/(m²K)

Assembly No. 5 — Building assembly description: Sloped Roof — Interior insulation?

Heat transfer resistance [m²K/W]: interior Rsi: 0.10; exterior R_{se}: 0.10

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum	0.250					13
2.	Polyiso	0.024					25
3.	Cellulose w I Joists	0.042		0.130			140
4.	Cellulose w I Joists	0.042					330
5.	Cellulose w I Joists	0.042		0.130			140
6.							
7.							
8.							

Percentage of Sec. 2: 9.4% — Percentage of Sec. 3: — Total: 64.8 cm

U-Value: 0.067 W/(m²K)

Assembly No. 6 — Building assembly description: — Interior insulation?

Heat transfer resistance [m²K/W]: interior Rsi: ; exterior R_{se}:

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of Sec. 2: — Percentage of Sec. 3: — Total: cm

U-Value: W/(m²K)

Passive House verification

HEAT LOSSES VIA THE GROUND

Ground Characteristics			
Thermal Conductivity	λ	2.0	W/(mK)
Heat Capacity	ρc	2.0	MJ/(m³K)
Periodic Penetration Depth	δ	3.17	m

Climate Data			
Av. Indoor Temp. Winter	T_i	20.0	°C
Av. Indoor Temp. Summer	T_i	25.0	°C
Average Ground Surface Temperatur	$T_{g,ave}$	7.0	°C
Amplitude of $T_{g,ave}$	$T_{g,\wedge}$	15.8	°C
Length of the Heating Period	n	7.3	months
Heating Degree Hours - Exterior	G_t	115.2	kKh/a

Building Data							
Floor Slab Area	A	152.7	m²	U-value floor slab/basement ceiling	U_f	0.079	W/(m²K)
Floor Slab Perimeter	P	55.2	m	Thermal bridges floor slab/basement	Ψ_B*l	0.00	W/K
Charact. Dimension of Floor Slab	B'	5.53	m	U-value floor slab/basement ceiling in	U_f'	0.079	W/(m²K)
				Eq. Thickness Floor	d_t	25.27	m

Floor Slab Type (select only one)			
x	Heated Basement or Underground Floor Slab		Unheated basement
	Slab on Grade		Suspended Floor

For Basement or Underground Floor Slab							
Basement Depth	z	3.00	m	U-Value Belowground Wall	U_{wB}	0.074	W/(m²K)
Additionally for Unheated Basements				Height Aboveground Wall	h		m
Air Change Unheated Basement	n		h^{-1}	U-Value Aboveground Wall	U_W	0.069	W/(m²K)
Basement Volume	V		m³	U-Value Basement Floor Slab	U_{fB}		W/(m²K)

For Perimeter Insulation for Slab on Grade			
Perimeter Insulation Width/Depth	D		m
Perimeter Insulation Thickness	d_n		m
Conductivity Perimeter Insulation	λ_n		W/(mK)
Orientation of the Perimeter Ins.	horizontal		
(check only one field)	vertical		

For Suspended Floor			
U-Value Crawl Space	U_{Crawl}		W/(m²K)
Height of Crawl Space Wall	h		m
U-Value Crawl Space Wall	U_W		W/(m²K)
Area of Ventilation Openings	εP		m²
Wind Velocity at 10 m Height	v	4.0	m/s
Wind Shield factor	f_W	0.05	-

Additional Thermal Bridge Heat Losses at Perimeter							
				Steady-State Fraction	$\Psi_{P,stat}$*l	0.000	W/K
Phase Shift	β		months	Harmonic Fraction	$\Psi_{P,harm}$*l	0.000	W/K

Groundwater Correction							
Depth of the Groundwater Table	z_w	3.0	m	Transm. Belowground El. (w/o Ground)	L_{reg}	24.40	W/K
Groundwater Flow Rate	q_w	0.05	m/d	Relative Insulation Standard	d_t/B'	4.71	-
				Relative Groundwater Depth	z_w/B'	0.54	-
Groundwater Correction Factor	G_w	1.0027222	-	Relative Groundwater Velocity	l/B'	0.15	-

Basement or Underground Floor Slab							
Eq. Thickness Floor Slab	d_t	25.3	m	Phase Shift	β	1.45	months
U-Value Floor Slab	U_{bf}	0.07	W/(m²K)	Exterior Periodic Transmittance	L_{pe}	7.44	W/K
Eq. Thickness Basement Wall	d_w	26.89	m				
U-Value Wall	U_{bw}	0.06	W/(m²K)				
Steady-State Transmittance	L_S	21.24	W/K				

Unheated Basement					
Steady-State Transmittance	L_S	W/K	Phase Shift	β	months
			Exterior Periodic Transmittance	L_{pe}	W/K

Slab on Grade				
Heat Transfer Coefficient	U_0	W/(m²K)	Phase Shift	β	months
Eq. Ins. Thickness Perimeter Ins.	d'	m	Exterior Periodic Transmittance	L_{pe}	W/K
Perimeter Insulation Correction	$\Delta\Psi$	W/(mK)			
Steady-State Transmittance	L_S	W/K			

Suspended Floor Above a Ventilated Crawl Space (at max. 0.5 m Below Ground)				
Eq. Ins. Thickness Crawl Space	d_g	m	Phase Shift	β	months
U-Value Crawl Space Floor Slab	U_g	W/(m²K)	Exterior Periodic Transmittance	L_{pe}	W/K
U-Value Crawl Space Wall & Vent.	U_X	W/(m²K)			
Steady-State Transmittance	L_S	W/K			

Interim Results

Phase Shift	β	1.45	months	Steady-State Heat Flow	Φ_{stat}	276.7 W
Steady-State Transmittance	L_S	21.24	W/K	Periodic Heat Flow	Φ_{harm}	41.6 W
Exterior Periodic Transmittance	L_{pe}	7.44	W/K	Heat Losses During Heating Period	Q_{tot}	1705 kWh

Ground reduction factor for "Annual Heating Demand" sheet **0.61**

Monthly Average Ground Temperatures for Monthly Method

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average Val
Winter	5.2	4.0	4.1	5.4	7.5	10.0	12.1	13.3	13.3	12.0	9.8	7.3	8.7
Summer	5.8	4.6	4.7	6.0	8.2	10.7	12.8	14.0	13.9	12.6	10.4	7.9	9.3

Design Ground Temperature for Heating Load Sheet 4.0 **for Cooling Load Sheet** 14.0

Passive House verification

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: Casa Tortuga

Annual heating demand: 15 kWh/(m²a)

Heating degree hours: 115.2

Climate: Ottawa

Window area orientation	Global radiation (cardinal points)	Shading	Dirt	Non-perpendicular incident radiation	Glazing fraction	g-Value	Reduction factor for solar radiation	Window area	Window U-Value	Glazing area	Average global radiation	Transmission losses	Heat gains solar radiation
maximum:	kWh/(m²a)	0.75	0.95	0.85				m²	W/(m²K)	m²	kWh/(m²a)	kWh/a	kWh/a
North	142	0.33	0.95	0.85	0.372	0.51	0.10	1.12	0.97	0.4	142	125	8
East	392	0.36	0.95	0.85	0.687	0.51	0.20	10.05	0.77	6.9	392	893	397
South	756	0.40	0.95	0.85	0.795	0.61	0.25	37.99	0.77	30.2	756	3373	4457
West	400	0.39	0.95	0.85	0.762	0.32	0.24	6.00	1.09	4.6	400	751	186
Horizontal	600	1.00	0.95	0.85	0.000	0.00	0.00	0.00	0.00	0.0	600	0	0
		Total or Average Value for All Windows.				0.56	0.24	55.15	0.81	42.1		5142	5048

Quantity	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Window rough openings: Width	Window rough openings: Height	Installed in Area in the Areas worksheet	Nr.	Glazing: Select glazing from the WinType worksheet	Nr.	Frame: Select window from the WinType worksheet	Nr.	g-Value: Perpendicular Radiation	U-Value: Glazing	U-Value: Frames (centre)	Ψ-Spacer: Ψ_{spacer} (centre)	Installation: Left 1/0	Right 1/0	Bottom 1/0	Top 1/0	$\Psi_{installation}$ left	$\Psi_{installation}$ right	$\Psi_{installation}$ bottom	$\Psi_{installation}$ top	$\Psi_{installation}$ Average value	Results (unhide cells to make U- & Ψ-values from WinType worksheet visible): Window Area	Glazing Area	U-Value Window	Glazed Fraction per Window
		Degrees	Degrees		m	m	Select:		Select:		Select:		-	W/(m²K)	W/(m²K)	W/(mK)					W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	m²	m²	W/(m²K)	%
1	wi-e-1	90	90	East	1.220	1.220	Wall East 1	4	[illegible]	2	[illegible]	1	0.51	0.50	0.79	0.036	1	1	1	1					0.023	1.5	0.96	0.77	65%
1	wi-e-2	90	90	East	0.610	1.220	[illegible]	4	[illegible]	2	[illegible]	2	0.51	0.50	0.79	0.036	0	1	1	1					0.023	0.7	0.42	0.84	57%
1	wi-e-3	90	90	East	1.220	1.220	[illegible]	4	[illegible]	2	[illegible]	8	0.51	0.50	0.79	0.036	0	1	1	1					0.023	1.5	1.17	0.72	78%
1	wi-e-4	90	90	East	1.220	1.220	[illegible]	4	[illegible]	2	[illegible]	8	0.51	0.50	0.79	0.036	0	1	1	1					0.023	1.5	1.17	0.72	78%
1	wi-e-5	90	90	East	0.610	1.220	[illegible]	4	[illegible]	2	[illegible]	2	0.51	0.50	0.79	0.036	0	1	1	1					0.023	0.7	0.42	0.84	57%
1	wi-e-6	90	90	East	0.610	1.220	[illegible]	4	[illegible]	2	[illegible]	2	0.51	0.50	0.79	0.036	0	1	1	1					0.023	0.7	0.42	0.84	57%
1	wi-e-7	90	90	East	1.220	1.220	[illegible]	4	[illegible]	2	[illegible]	8	0.51	0.50	0.79	0.036	0	1	1	1					0.023	1.5	1.17	0.72	78%
1	wi-e-8	90	90	East	1.220	1.220	[illegible]	4	[illegible]	2	[illegible]	1	0.51	0.50	0.79	0.036	1	1	1	1					0.023	1.5	0.96	0.77	65%
1	wi-e-9	90	90	East	0.610	0.610	[illegible]	4	[illegible]	2	[illegible]	7	0.51	0.50	0.79	0.036	1	1	1	1					0.023	0.4	0.20	0.95	54%
1	wi-n-1	0	90	North	0.610	0.610	[illegible]	9	[illegible]	2	[illegible]	1	0.51	0.50	0.79	0.036	1	1	1	1					0.023	0.4	0.14	0.97	37%
1	wi-n-2	0	90	North	0.610	0.610	[illegible]	9	[illegible]	2	[illegible]	1	0.51	0.50	0.79	0.036	1	1	1	1					0.023	0.4	0.14	0.97	37%
1	wi-n-3	0	90	North	0.610	0.610	[illegible]	9	[illegible]	2	[illegible]	1	0.51	0.50	0.79	0.036	1	1	1	1					0.023	0.4	0.14	0.97	37%
1	wi-s-1	180	90	South	0.610	1.220	[illegible]	11	[illegible]	1	[illegible]	2	0.61	0.60	0.79	0.036	0	1	1	1					0.023	0.7	0.42	0.89	57%
1	wi-s-10	180	90	South	2.290	1.830	[illegible]	12	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	4.2	3.62	0.73	86%
1	wi-s-11	180	90	South	1.220	2.120	[illegible]	11	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	2.16	0.76	83%
1	wi-s-12	180	90	South	1.220	2.120	[illegible]	11	[illegible]	1	[illegible]	3	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	2.07	0.76	80%
1	wi-s-13	180	90	South	1.220	2.120	[illegible]	11	[illegible]	1	[illegible]	3	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	2.07	0.76	80%
1	wi-s-14	180	90	South	1.220	2.120	[illegible]	11	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	2.16	0.76	83%
1	wi-s-15	180	90	South	1.830	1.220	[illegible]	11	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	2.2	1.81	0.78	81%
1	wi-s-16	180	90	South	0.610	1.220	[illegible]	11	[illegible]	1	[illegible]	2	0.61	0.60	0.79	0.036	0	1	1	1					0.023	0.7	0.42	0.89	57%
1	wi-s-17	180	90	South	0.610	0.610	[illegible]	11	[illegible]	1	[illegible]	7	0.61	0.60	0.79	0.036	1	1	1	1					0.023	0.4	0.20	1.01	54%
1	wi-s-2	180	90	South	1.830	1.220	[illegible]	11	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	2.2	1.81	0.78	81%
1	wi-s-3	180	90	South	0.910	1.220	[illegible]	11	[illegible]	1	[illegible]	1	0.61	0.60	0.79	0.036	1	1	1	1					0.022	1.1	0.66	0.87	59%
1	wi-s-4	180	90	South	1.220	2.130	[illegible]	11	[illegible]	1	[illegible]	2	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	1.97	0.77	76%
1	wi-s-5	180	90	South	1.220	2.130	[illegible]	11	[illegible]	1	[illegible]	2	0.61	0.60	0.79	0.036	0	1	1	1					0.023	2.6	1.97	0.77	76%
1	wi-s-6	180	90	South	0.880	1.180	[illegible]	11	[illegible]	1	[illegible]	1	0.61	0.60	0.79	0.036	1	1	1	1					0.022	1.0	0.60	0.88	58%
1	wi-s-7	180	90	South	2.290	1.220	[illegible]	12	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	2.8	2.30	0.77	82%
1	wi-s-8	180	90	South	2.290	1.220	[illegible]	12	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	2.8	2.30	0.77	82%
1	wi-s-9	180	90	South	2.290	1.830	[illegible]	12	[illegible]	1	[illegible]	8	0.61	0.60	0.79	0.036	0	1	1	1					0.024	4.2	3.62	0.73	86%
1	wi-w-1	270	90	West	1.070	2.130	[illegible]	13	[illegible]	11	[illegible]	11	0.00	1.60	1.60	0.000	1	1	1	1					0.028	2.3	1.68	1.68	74%
1	wi-w-2	270	90	West	1.220	1.830	[illegible]	14	[illegible]	2	[illegible]	7	0.51	0.50	0.79	0.036	1	1	1	1					0.022	2.2	1.77	0.71	79%
1	wi-w-3	270	90	West	1.220	1.220	[illegible]	14	[illegible]	2	[illegible]	7	0.51	0.50	0.79	0.036	1	1	1	1					0.023	1.5	1.12	0.75	75%
								0		0		0																	
								0		0		0																	
								0		0		0																	
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								0		0		0																	
								0		0		0																	

Passive House verification

GLAZING ACCORDING TO CERTIFICATION

Go to curtain wall facades / window frames from line 99 onwards

	Type		
Assem-bly No.	Glazing	g-Value	U_g-Value
			W/(m²K)
1	South Glass	0.61	0.60
2	N,E,W, Glass	0.51	0.50
3			
4			
5			
6			
7			
8			
9			
10			
11	Solid Door North	0.00	1.60

Passive House verification

CURTAIN WALL FACADE / WINDOW FRAME AS PER CERTIFICATE

Go to glazing from line 2 onwards

	Type	U_f-Value				Frame Dimensions				Thermal bridges								
Assem-bly No.	Window frame	Frame left	Frame right	Frame bottom	Frame top	Width - Left	Width - Right	Width - Below	Width - Above	Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
	Curtain wall facade	Post left	Post right	Beam bottom	Beam top	Post left	Post right	Beam bottom	Beam top	$\Psi_{Glazing\ edge}$ left	$\Psi_{Glazing\ edge}$ right	$\Psi_{Glazing\ edge}$ bottom	$\Psi_{Glazing\ edge}$ top	$\Psi_{installation}$ left	$\Psi_{installation}$ right	$\Psi_{installation}$ bottom	$\Psi_{installation}$ top	χ_{GC} -value Glass carrier
		W/(m²K)	W/(m²K)	W/(m²K)	W/(m²K)	m	m	m	m	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/K
1	Casement	0.79	0.79	0.79	0.79	0.119	0.119	0.119	0.119	0.036	0.036	0.036	0.036	0.020	0.020	0.030	0.020	
2	casement half 1 side	0.79	0.79	0.79	0.79	0.060	0.119	0.119	0.119	0.036	0.036	0.036	0.036	0.020	0.020	0.030	0.020	
3	casement half 2 side	0.79	0.79	0.79	0.79	0.060	0.060	0.119	0.119	0.036	0.036	0.036	0.036	0.020	0.020	0.030	0.020	
4																		
5																		
6																		
7	Fixed	0.79	0.79	0.79	0.79	0.080	0.080	0.080	0.080	0.036	0.036	0.036	0.036	0.020	0.020	0.030	0.020	
8	Fixed half 1 side	0.79	0.79	0.79	0.79	0.040	0.080	0.080	0.080	0.036	0.036	0.036	0.036	0.020	0.020	0.030	0.020	
9																		
10																		
11	Door	1.60	1.60	1.60	1.60	0.100	0.100	0.100	0.100	0.000	0.000	0.000	0.000	0.025	0.025	0.040	0.025	

Passive House verification

VENTILATION DATA

Building: Casa Tortuga

Treated floor area A_{TFA}		m²	225	*(Areas worksheet)*
Room height h		m	2.5	*(Annual Heating Demand worksheet)*
Room ventilation volume (A_{TFA}*h) =	V_V	m³	563	*(Annual Heating Demand worksheet)*

Type of ventilation system

x	Balanced PH ventilation	*Please Check*
	Pure extract air	

Infiltration air change rate

Wind protection coefficients e and f		
Coefficient e for screening class	Several sides exposed	One side exposed
No screening	0.10	0.03
Moderate screening	0.07	0.02
High screening	0.04	0.01
Coefficient f	15	20

			for Annual Demand:	for Heating Load:	Net Air Volume for Press. Test	V_{n50}	q_{50}	
Wind protection coefficient, e			0.04	0.10				
Wind protection coefficient, f			15	15				
Air Change Rate at Press. Test	n_{50}	1/h	0.35	0.35	580	m³	0.30	m³/(hm²)

			for Annual Demand:	for Heating Load:
Excess extract air		1/h	0.00	0.00
Infiltration air change rate	$n_{V,Res}$	1/h	**0.014**	**0.036**

Selection of ventilation data input - Results

The PHPP offers two methods for dimensioning the air quantities and choosing the ventilation unit. Fresh air or extract air quantities for residential buildings and parameters for ventilation can be determined using the standard planning option in the 'Ventilation' sheet. The 'Additional Vent' sheet has been created for more complex ventilation systems and allows up to 10 diff Furthermore, air quantities can be determined on a room-by-room or zone-by-zone basis. Please select your design method here.

	Ventilation unit / Heat recovery efficiency design		Mean Air exchange	Mean Air Change Rate	Extract air excess (Extract air system)	Effective heat recovery efficiency Unit	Specific power input	Heat recovery efficiency SHX
x	Sheet Ventilation (Standard design)	*(Sheet Ventilation see below)*	m³/h	1/h	1/h	[-]	Wh/m³	
	Sheet Extended ventilation	*(Sheet Additional Vent)*						
	(Multiple ventilation units, non-residential buildings)		**169**	**0.30**	**0.00**	**78.5%**	**0.31**	**19.0%**

SHX efficiency η^*_{SHX} 50%

STANDARD INPUT FOR BALANCED VENTILATION

Ventilation dimensioning for systems with one ventilation unit

Occupancy	m²/P	35				
Number of occupants	P	6.4				
Supply air per person	m³/(P*h)	30				
Supply air requirement	m³/h	193		Bathroom		
Extract air rooms		Kitchen	Bathroom	(shower only)	WC	ntry/Laundry
Quantity		1	1	1	1	2
Extract air requirement per room	m³/h	60	40	20	20	20
Total Extract Air Requirement	m³/h	180				

Design air flow rate (maximum) m³/h 219

Average air change rate calculation

Type of operation	Daily operation duration h/d	Factors referenced to maximum	Air flow rate m³/h	Air change rate 1/h
Maximum		1.00	219	0.39
Standard	24.0	0.77	169	0.30
Basic		0.54	118	0.21
Minimum		0.40	88	0.16
	Average value	0.77	Average air flow rate (m³/h) 169	Average air change rate (1/h) 0.30

Selection of ventilation unit with heat recovery

x	Central unit within the thermal envelope.
	Central unit outside of the thermal envelope.

Ventilation unit selection	Heat recovery efficiency Unit η_{HR}	Specific power input [Wh/m³]	Application range [m³/h]	Frost protection required	Unit noise level < 35dB(A)
Zehnder - ComfoAir550, ComfoD550, WHR960	0.84	0.31	110 - 308	yes	no

Conductance value of outdoor air duct Ψ	W/(mK)	0.607	See calculation below
Length of outdoor air duct	m	2.84	
Conductance value of exhaust air duct Ψ	W/(mK)	0.607	See calculation below
Length of exhaust air duct	m	4.24	
Temperature of mechanical services room	°C	20	
(Enter only if the central unit is outside of the thermal envelope.)			

Room Temperature (°C)	20
Av. Ambient Temp. Heating P. (°C)	-1.0
Av. Ground Temp (°C)	7.0

Effective heat recovery efficiency $\eta_{HR,eff}$ **78.5%**

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	50%	confofond brine geothermal heat exchanger
Heat recovery efficiency SHX	η_{SHX}	19%	

Secondary calculation

Ψ-value supply or ambient air duct

Nominal width:	180	mm
Insul. Thickness	30	mm
Reflective? Please mark with an "x"!		
Yes		
x No		
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	169	m³/h
Δϑ	21	K
Exterior duct diameter	0.180	m
Exterior diameter	0.240	m
α-Interior	8.86	W/(m²K)
α–Surface	6.33	W/(m²K)
Ψ-value	**0.607**	**W/(mK)**
Surface temperature difference	2.675	K

Secondary calculation

Ψ-value extract or exhaust air duct

Nominal width:	180	mm
Insul. Thickness:	30	mm
Reflective? Please mark with an "x"!		
Yes		
x No		
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	169	m³/h
Δϑ	21	K
Exterior duct diameter	0.180	m
Exterior diameter	0.240	m
α-Interior	8.86	W/(m²K)
α–Surface	6.33	W/(m²K)
Ψ-value	**0.607**	**W/(mK)**
Surface temperature difference	2.675	K

Passive House verification

CALCULATING SHADING FACTORS

Climate: Ottawa

Building: Casa Tortuga

Latitude: 45.42 °

Orientation	Glazing area m^2	Reduction factor r_S
North	0.42	33%
East	6.90	36%
South	30.19	40%
West	4.57	39%
Horizontal	0.00	100%

Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional shading reduction factor	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%
					w_G	h_G	A_G	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	r_{other}	r_H	r_R	r_O	r_S
1	wi-e-1	90	90	East	0.98	0.98	1.0			0.34	0.088	1.73	0.42	59%	100%	79%	60%	28%
1	wi-e-2	90	90	East	0.43	0.98	0.4			0.34	0.698	1.73	0.42	59%	100%	86%	60%	30%
1	wi-e-3	90	90	East	1.10	1.06	1.2			0.34	0.393	1.73	0.42	59%	100%	86%	61%	31%
1	wi-e-4	90	90	East	1.10	1.06	1.2			0.34	0.393	1.73	1.90	59%	100%	86%	82%	41%
1	wi-e-5	90	90	East	0.43	0.98	0.4			0.34	0.698	1.73	1.90	59%	100%	86%	81%	41%
1	wi-e-6	90	90	East	0.43	0.98	0.4			0.34	0.698	1.73	1.95	59%	100%	86%	82%	41%
1	wi-e-7	90	90	East	1.10	1.06	1.2			0.34	0.393	1.73	1.95	59%	100%	86%	82%	42%
1	wi-e-8	90	90	East	0.98	0.98	1.0			0.34	0.088	1.73	1.18	59%	100%	79%	75%	35%
1	wi-e-9	90	90	East	0.45	0.45	0.2			0.34	0.088	1.73	1.18	59%	100%	65%	71%	27%
1	wi-n-1	0	90	North	0.37	0.37	0.1			0.34	0.088	0.34	0.09	65%	100%	72%	72%	33%
1	wi-n-2	0	90	North	0.37	0.37	0.1			0.34	0.088	0.34	0.09	65%	100%	72%	72%	33%
1	wi-n-3	0	90	North	0.37	0.37	0.1			0.34	0.088	0.34	0.09	65%	100%	72%	72%	33%
1	wi-s-1	180	90	South	0.43	0.98	0.4			0.34	1.003	4.00	0.40	66%	100%	94%	46%	28%
1	wi-s-10	180	90	South	2.17	1.67	3.6			0.34	1.233	1.86	0.43	66%	100%	97%	77%	49%
1	wi-s-11	180	90	South	1.10	1.96	2.2			0.34	1.918	3.99	0.43	66%	100%	97%	61%	39%
1	wi-s-12	180	90	South	1.10	1.88	2.1			0.34	1.918	3.99	0.43	66%	100%	97%	60%	38%
1	wi-s-13	180	90	South	1.10	1.88	2.1			0.34	1.918	3.99	0.43	66%	100%	97%	60%	38%
1	wi-s-14	180	90	South	1.10	1.96	2.2			0.34	1.918	3.99	0.43	66%	100%	97%	61%	39%
1	wi-s-15	180	90	South	1.71	1.06	1.8			0.34	0.393	3.99	0.43	66%	100%	94%	49%	30%
1	wi-s-16	180	90	South	0.43	0.98	0.4			0.34	1.003	3.99	0.43	66%	100%	94%	47%	29%
1	wi-s-17	180	90	South	0.45	0.45	0.2			0.34	0.088	3.99	0.43	66%	100%	77%	35%	18%
1	wi-s-2	180	90	South	1.71	1.06	1.8			0.34	0.393	4.00	0.40	66%	100%	94%	48%	29%
1	wi-s-3	180	90	South	0.67	0.98	0.7			0.34	0.088	4.00	0.40	66%	100%	83%	46%	25%
1	wi-s-4	180	90	South	1.04	1.89	2.0			0.34	0.698	4.00	0.40	66%	100%	94%	60%	37%
1	wi-s-5	180	90	South	1.04	1.89	2.0			0.34	0.698	4.00	0.40	66%	100%	94%	60%	37%
1	wi-s-6	180	90	South	0.64	0.94	0.6			0.34	0.088	4.00	0.40	66%	100%	82%	45%	24%
1	wi-s-7	180	90	South	2.17	1.06	2.3			0.34	1.233	1.86	0.40	66%	100%	97%	71%	45%
1	wi-s-8	180	90	South	2.17	1.06	2.3			0.34	1.233	1.86	0.40	66%	100%	97%	71%	45%
1	wi-s-9	180	90	South	2.17	1.67	3.6			0.34	1.233	1.86	0.43	66%	100%	97%	77%	49%
1	wi-w-1	270	90	West	0.87	1.93	1.7			0.34	0.838	0.39	0.14	56%	100%	89%	90%	45%
1	wi-w-2	270	90	West	1.06	1.67	1.8			0.34	0.088	0.39	0.14	56%	100%	80%	89%	40%
1	wi-w-3	270	90	West	1.06	1.06	1.1			0.34	0.088	0.39	0.14	56%	100%	80%	85%	38%
										0.34	0.088	0.34	0.088					

Passive House verification

SPECIFIC ANNUAL HEATING DEMAND

Climate: Ottawa
Building: Casa Tortuga

Interior Temperature: 20.0 °C
Building Type/Use: Residential
Treated Floor Area A_{TFA}: 225.1 m²

Building Element	Temperature Zone	Area m²		U-Value W/(m²K)		Temp. Factor f_t		G_t kKh/a		kWh/a	per m² Treated Floor Area
Exterior Wall - Ambient	A	197.3	*	0.069	*	1.00	*	115.2	=	1562	6.94
Exterior Wall - Ground	B	100.7	*	0.074	*	0.61	*	115.2	=	523	2.32
Roof/Ceiling - Ambient	A	166.0	*	0.066	*	1.00	*	115.2	=	1263	5.61
Floor slab / basement ceiling	B	152.7	*	0.079	*	0.61	*	115.2	=	844	3.75
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
	X		*		*	0.75	*		=		
Windows	A	55.1	*	0.809	*	1.00	*	115.2	=	5142	22.85
Exterior Door	A		*		*	1.00	*		=		
Exterior TB (length/m)	A		*		*	1.00	*		=		
Perimeter TB (length/m)	P		*		*	0.61	*		=		0.00
Ground TB (length/m)	B		*		*	0.61	*		=		
Total of All Building Envelope Areas		671.7									kWh/(m²a)

Transmission Heat Losses Q_T — Total: 9335 kWh/a; 41.5 kWh/(m²a)

Ventilation System:

		A_{TFA} m²		Clear Room Height m	=	m^3
Effective Air Volume, V_V		225.1	*	2.50	=	562.6
Effective Heat Recovery Efficiency	η_{eff} 78%					
of Heat Recovery						
Efficiency of Subsoil Heat Exchanger	η_{SHX} 19%					

	$n_{V,system}$ 1/h		Φ_{HR}		$n_{V,Res}$ 1/h	=	1/h
Energetically Effective Air Exchange n_v	0.300	* (1 -	0.83	) +	0.014	=	0.067

Ventilation Heat Losses Q_V

V_V m³		n_V 1/h		c_{Air} Wh/(m³K)		G_t kKh/a	=	kWh/a	kWh/(m²a)
563	*	0.067	*	0.33	*	115.2	=	1430	6.4

Total Heat Losses Q_L

(Q_T kWh/a		Q_V kWh/a	)	Reduction Factor Night/Weekend Saving	=	kWh/a	kWh/(m²a)
(9335	+	1430	)	1.0	=	10766	47.8

Available Solar Heat Gains Q_S

Orientation of the Area	Reduction Factor See Windows Sheet		g-Value (perp. radiation)		Area m²		Radiation HP kWh/(m²a)	=	kWh/a
1. North	0.10	*	0.51	*	1.12	*	142	=	8
2. East	0.20	*	0.51	*	10.05	*	392	=	397
3. South	0.25	*	0.61	*	37.99	*	756	=	4457
4. West	0.24	*	0.32	*	6.00	*	400	=	186
5. Horizontal	0.00	*	0.00	*	0.00	*	600	=	0
							Total		5048

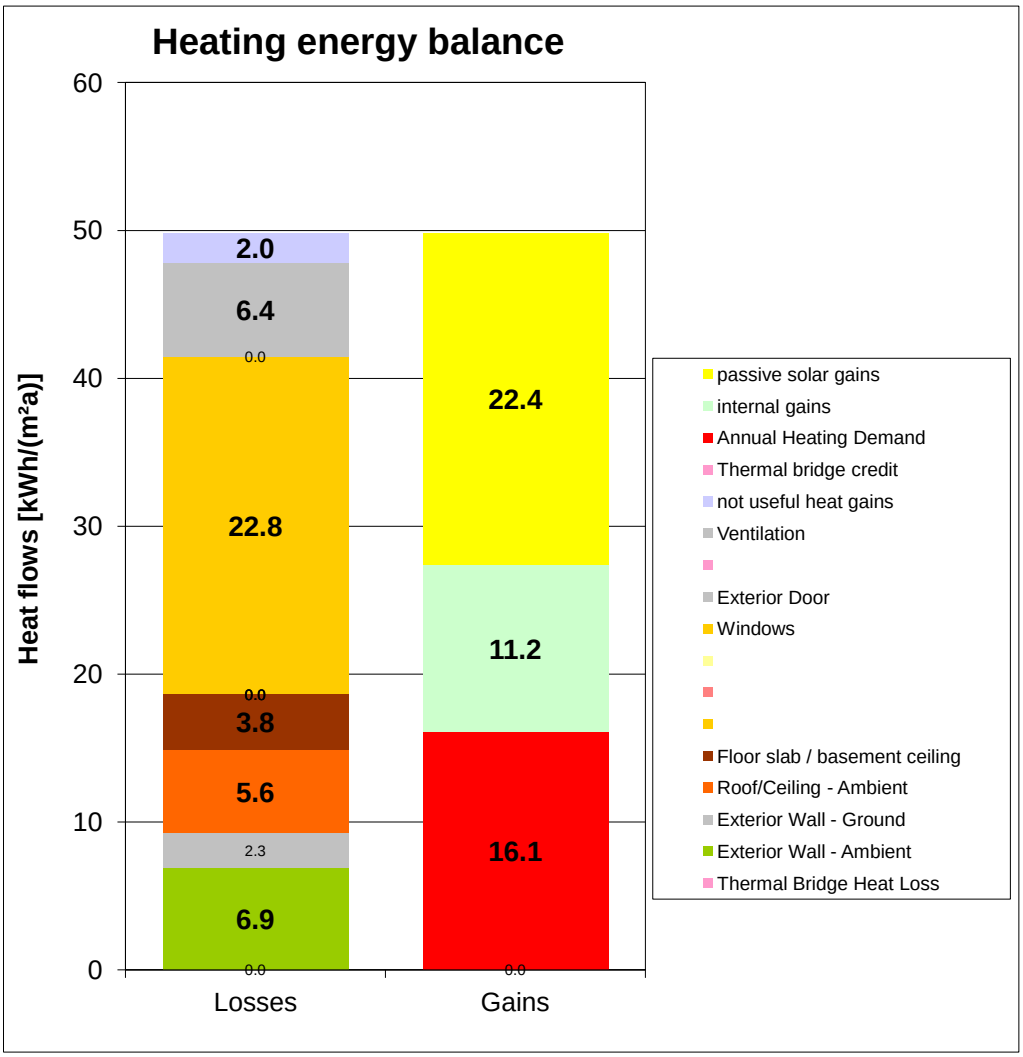
kWh/(m²a): 22.4

Internal Heat Gains Q_I

kh/d		Length Heat. Period d/a		Spec. Power q_I W/m²		A_{TFA} m²	=	kWh/a	kWh/(m²a)
0.024	*	223	*	2.10	*	225.1	=	2532	11.2

		kWh/a	kWh/(m²a)
Free Heat Q_F	$Q_S + Q_I$ =	7580	33.7
Ratio of Free Heat to Losses	Q_F / Q_L =	0.70	
Utilisation Factor Heat Gains η_G	$(1 - (Q_F/Q_L)^5) / (1 - (Q_F/Q_L)^6)$ =	94%	
Heat Gains Q_G	$\eta_G * Q_F$ =	7138	31.7
Annual Heating Demand QH	$Q_L - Q_G$ =	3627	16

	kWh/(m²a)		(Yes/No)
Limiting Value	15	**Requirement met?**	no


Heating energy balance
Heat flows [kWh/(m²a)]
60
50
40
30
20
10
0
2.0
6.4
0.0
22.8
0.0
3.8
5.6
2.3
6.9
0.0
22.4
11.2
16.1
0.0
Losses
Gains
passive solar gains
internal gains
Annual Heating Demand
Thermal bridge credit
not useful heat gains
Ventilation
Exterior Door
Windows
Floor slab / basement ceiling
Roof/Ceiling - Ambient
Exterior Wall - Ground
Exterior Wall - Ambient
Thermal Bridge Heat Loss

Passive House verification

SPECIFIC ANNUAL HEATING DEMAND
MONTHLY METHOD

(This page displays the sums of the monthly method over the heating period)

Climate: Ottawa
Building: Casa Tortuga
Spec. Capacity: 132 Wh/(m²K) (Enter in "Summer" worksheet.)

Interior Temperature: 20 °C
Building Type/Use: Residential
Treated Floor Area A_{TFA}: 225.1 m²

Building Element	Temperature Zone	Area m²		U-Value W/(m²K)		Month. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
Exterior Wall - Ambient	A	197.3	*	0.069	*	1.00	*	112	=	1523	
Exterior Wall - Ground	B	100.7	*	0.074	*	1.00	*	67	=	501	
Roof/Ceiling - Ambient	A	166.0	*	0.066	*	1.00	*	112	=	1232	
Floor slab / basement ceiling	B	152.7	*	0.079	*	1.00	*	67	=	809	
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
	X		*		*	0.75	*		=		
Windows	A	55.1	*	0.809	*	1.00	*	112	=	5014	
Exterior Door	A		*		*	1.00	*		=		
Exterior TB (length/m)	A		*		*	1.00	*		=		
Perimeter TB (length/m)	P		*		*	1.00	*		=		
Ground TB (length/m)	B		*		*	1.00	*		=		

Transmission Heat Losses Q_T — Total 9079 kWh/a — 40.3 kWh/(m²a)

Effective Air Volume V_{RAX}: A_{TFA} 225 m² * Clear Room Height 2.50 m = 563 m³

	$n_{V,system}$ 1/h		η*$_{SHX}$		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{v,e}$	0.300	*(1-	50%	)*(1-	0.78	)+	0.014	=	0.047
Effective Air Change Rate Ground $n_{V,g}$	0.300	*	50%	*(1-	0.78	)		=	0.032

	V_{RAX} m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation Losses Ambient Q_V	563	*	0.047	*	0.33	*	112	=	976	4.3
Ventilation Losses Ground $Q_{V,e}$	563	*	0.032	*	0.33	*	66	=	398	1.8

Ventilation Heat Losses Q_V — Total 1374 kWh/a — 6.1 kWh/(m²a)

Total Heat Losses Q_L = (Q_T 9079 kWh/a + Q_V 1374 kWh/a) * Reduction Factor Night/Weekend Saving 1.0 = 10454 kWh/a — 46.5 kWh/(m²a)

Orientation of the Area	Reduction Factor See Windows worksheet		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
North	0.10	*	0.51	*	1.1	*	130	=	7
East	0.20	*	0.51	*	10.0	*	363	=	368
South	0.25	*	0.61	*	38.0	*	730	=	4303
West	0.24	*	0.32	*	6.0	*	371	=	173
Horizontal	0.00	*	0.00	*	0.0	*	552	=	0
Sum Opaque Areas									0

Available Solar Heat Gains Q_S — Total 4851 kWh/a — 21.6 kWh/(m²a)

Internal Heat Gains Q_I: kh/d 0.024 * Length Heat. Period 212 d/a * Spec. Power q_i 2.1 W/m² * A_{TFA} 225.1 m² = 2405 kWh/a — 10.7 kWh/(m²a)

Free Heat Q_F: Q_S + Q_I = 7256 kWh/a — 32.2 kWh/(m²a)

Ratio Free Heat to Losses: Q_F / Q_L = 0.69

Utilisation Factor Heat Gains η_G = 97%

Heat Gains Q_G: η_G * Q_F = 7065 kWh/a — 31.4 kWh/(m²a)

Annual Heating Demand QH: Q_L - Q_G = 3389 kWh/a — 15 kWh/(m²a)

Limiting Value 15 kWh/(m²a)

Requirement met? yes (Yes/No)

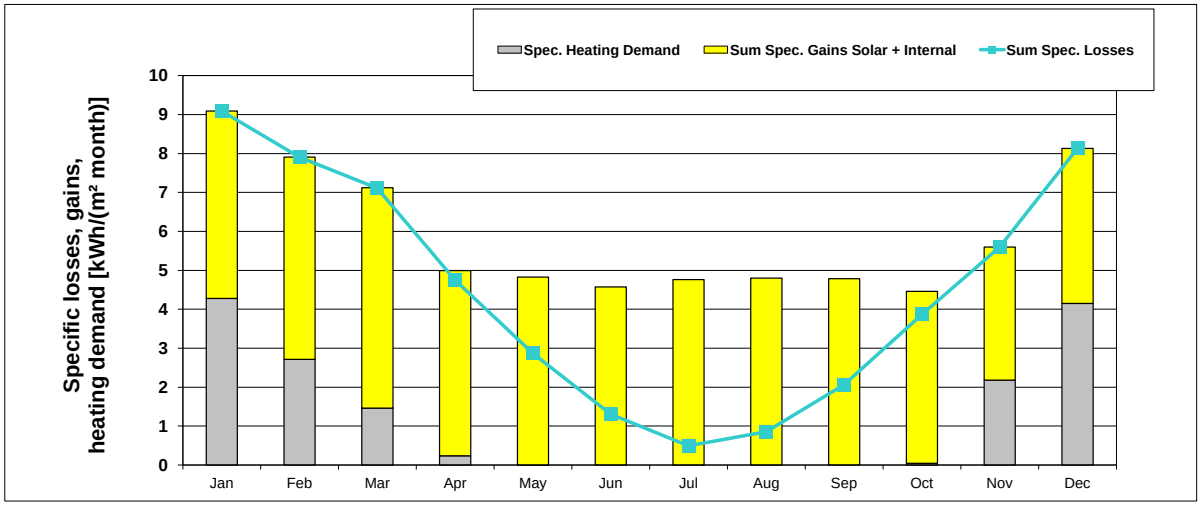
Passive House verification

SPECIFIC ANNUAL HEAT DEMAND
MONTHLY METHOD

Climate: Ottawa
Building: Casa Tortuga

Interior Temperature: 20 °C
Building Type/Use: Residential
Treated Floor Area A_{TFA}: 225 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - E	22.8	19.5	16.8	10.4	5.2	1.4	-0.7	0.6	4.0	8.9	13.6	20.4	123	kKh
Heating Degree Hours - G	11.0	10.8	11.9	10.5	9.3	6.7	5.4	4.5	4.8	6.0	7.4	9.5	98	kKh
Losses - Exterior	1772	1517	1309	807	405	106	-52	46	314	695	1059	1587	9564	kWh
Losses - Ground	274	263	290	263	240	188	163	146	151	175	200	243	2597	kWh
Sum Spec. Losses	9.1	7.9	7.1	4.8	2.9	1.3	0.5	0.9	2.1	3.9	5.6	8.1	54.0	kWh/m²
Solar Gains - North	1	1	1	2	3	3	3	2	2	1	1	1	19	kWh
Solar Gains - East	42	53	81	88	110	114	115	94	76	51	25	28	878	kWh
Solar Gains - South	672	772	802	601	572	525	554	589	625	566	389	501	7168	kWh
Solar Gains - West	18	26	38	39	49	47	48	42	34	25	14	14	394	kWh
Solar Gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar Gains - Opaque	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Internal Heat Gains	352	318	352	340	352	340	352	352	340	352	340	352	4140	kWh
Sum Spec. Gains Solar +	4.8	5.2	5.7	4.8	4.8	4.6	4.8	4.8	4.8	4.4	3.4	4.0	56.0	kWh/m²
Utilisation Factor	100%	100%	100%	95%	59%	29%	10%	18%	43%	87%	100%	100%	70%	
Annual Heating Demand	962	611	329	53	0	0	0	0	0	9	490	934	3389	kWh
Spec. Heating Demand	**4.3**	**2.7**	**1.5**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2.2**	**4.2**	**15.1**	kWh/m²



Passive House verification

SPECIFIC SPACE HEATING LOAD

Building: Casa Tortuga
Climate (HL): Ottawa
Building Type/Use: Residential
Treated Floor Area A_{TFA}: 225.1 m²
Interior Temperature: 20 °C

	Design Temperature		Radiation:	North	East	South	West	Horizontal	
Weather Condition 1:	-19.4	°C		16	58	147	44	67	W/m²
Weather Condition 2:	-14.0	°C		14	38	90	32	47	W/m²
Ground Design Temp.	4.0	°C							

	Building Element	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	197.3	*	0.069	*	1.00	*	39.4	or	34.0	=	534	or	461
2.	Exterior Wall - Ground	B	100.7	*	0.074	*	1.00	*	16.0	or	16.0	=	120	or	120
3.	Roof/Ceiling - Ambient	A	166.0	*	0.066	*	1.00	*	39.4	or	34.0	=	432	or	373
4.	Floor slab / basement ceiling	B	152.7	*	0.079	*	1.00	*	16.0	or	16.0	=	193	or	193
5.		A		*		*	1.00	*	39.4	or	34.0	=		or	
6.		A		*		*	1.00	*	39.4	or	34.0	=		or	
7.		X		*		*	0.75	*	39.4	or	34.0	=		or	
8.	Windows	A	55.1	*	0.809	*	1.00	*	39.4	or	34.0	=	1758	or	1517
9.	Exterior Door	A		*		*	1.00	*	39.4	or	34.0	=		or	
10.	Exterior TB (length/m)	A		*		*	1.00	*	39.4	or	34.0	=		or	
11.	Perimeter TB (length/m)	P		*		*	1.00	*	16.0	or	16.0	=		or	
12.	Ground TB (length/m)	B		*		*	1.00	*	16.0	or	16.0	=		or	
13.	House/DU Partition Wall	I		*		*	1.00	*	3.0	or	3.0	=		or	

Transmission Heat Losses P_T

Total = 3037 or 2664

Ventilation System:

Effective Air Volume, V_V: A_{TFA} 225.1 m² * Clear Room Height 2.50 m = 563 m³

Efficiency of Heat Recovery of the Heat Exchanger η_{HR} 78%
Heat Recovery Efficiency SHX 50%
Efficiency SHX η_{SHX} 1: 33% or η_{SHX} 2: 31%

Energetically Effective Air Exchange n_v: $n_{V,Res}$ (Heating Load) 0.036 1/h + $n_{V,system}$ 0.300 1/h *(1- Φ_{HR} 0.86 or Φ_{HR} 0.85) = 0.079 or 0.081 1/h

Ventilation Heating Load P_v

V_L m³		n_L 1/h		n_L 1/h	c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
562.6	*	0.079	or	0.081	* 0.33	*	39.4	or	34.0	=	579	or	510

Total Heating Load P_L

$P_T + P_V$ = 3616 or 3174 (P_L 1 W, P_L 2 W)

	Orientation the Area	Area m²		g-Value (perp. radiation)		Reduction Factor (see Windows worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_S 1 W		P_S 2 W
1.	North	1.1	*	0.5	*	0.1	*	16	or	14	=	1	or	1
2.	East	10.0	*	0.5	*	0.2	*	58	or	38	=	59	or	38
3.	South	38.0	*	0.6	*	0.3	*	147	or	90	=	867	or	531
4.	West	6.0	*	0.3	*	0.2	*	44	or	32	=	21	or	15
5.	Horizontal	0.0	*	0.0	*	0.4	*	67	or	47	=	0	or	0

Solar heating power P_S

Total = 947 or 585

Internal heating power P_I

Spec. Power 1.6 W/m² * A_{TFA} 225 m² = P_I 1: 360 or P_I 2: 360 W

Heating power (gains) P_G

$P_S + P_I$ = 1307 or 945 (P_G 1 W, P_G 2 W)

$P_L - P_G$ = 2310 or 2230

Heating Load P_H = 2310 W

Specific Heating Load P_H / A_{TFA} = 10.3 W/m²

Input Max. Supply Air Temperature °C
Max. Supply Air Temperature $\vartheta_{Supply,Max}$ 52 °C
Supply Air Temperature Without Heating $\vartheta_{Supply,Min}$: 14.4 °C or 14.9 °C

For Comparison: Heating Load Transportable by Supply Air. $P_{Supply\ Air,Max}$ = 2099 W specific: 9.3 W/m²

Supply Air Heating Sufficient? (Yes/No) No

Passive House verification

S U M M E R

Climate: Ottawa
Building: Casa Tortuga

Interior Temperature: 20 °C
Building Type/Use: Residential
Treated Floor Area A_{TFA}: 225.1 m²

Spec. Capacity: 132 Wh/K pro m² TFA
Overheating limit: 25 °C

	Building Element	Temperature Zone	Area m²		U-Value W/(m²K)		Red. Factor $f_{T,Summer}$		H_{Summer} Heat Conductance
1.	Exterior Wall - Ambier	A	197.3	*	0.069	*	1.00	=	13.6
2.	Exterior Wall - Ground	B	100.7	*	0.074	*	1.00	=	7.5
3.	Roof/Ceiling - Ambient	A	166.0	*	0.066	*	1.00	=	11.0
4.	Floor slab / basement	B	152.7	*	0.079	*	1.00	=	12.1
5.		A		*		*	1.00	=	
6.		A		*		*	1.00	=	
7.		X		*		*	0.75	=	
8.	Windows	A	55.1	*	0.809	*	1.00	=	44.6
9.	Exterior Door	A		*		*	1.00	=	
10.	Exterior TB (length/m)	A		*		*	1.00	=	
11.	Perimeter TB (length/m	P		*		*	1.00	=	
12.	Ground TB (length/m)	B		*		*	1.00	=	

Exterior Thermal Transmittance, $H_{T,e}$ 69.1 W/K
Ground Thermal Transmittance, $H_{T,g}$ 19.6 W/K

Heat Recovery Efficiency η_{HR} 78%
SHX Efficiency η^*_{SHX} 50%

Effective Air Volume V_v: A_{TFA} 225.1 m² * Clear Room Height 2.50 m = 563 m³

Summer Ventilation

continuous ventilation to provide sufficient indoor air quality

Air Change Rate by Natural (Windows & Leakages) or Exhaust-Only Mechanical Ventilation, Summer: 0.23 1/h

Mechanical Ventilation Summer: 0.30 1/h [ ] with HR (check if applicable)

Energetically Effective Airchange Rate n_v:
$n_{L,nat}$ 0.231 + $n_{V,system}$ 0.300 * (1 - Φ_{HR} 0.000) + $n_{V,Rest}$ 0.000 = 0.531 1/h

Ventilation Transm. Ambient $H_{V,e}$: V_V 563 m³ * $n_{V,equi,fraction}$ 0.381 1/h * c_{Air} 0.33 Wh/(m³K) = 70.8 W/K
Ventilation Transm. Ground $H_{V,g}$: 563 * 0.150 * 0.33 = 27.9 W/K

Additional Summer Ventilation for Cooling

Temperature amplitude summer 11.7 K

Select: [x] Window Night Ventilation, Manual
[ ] Mechanical, Automatically Controlled Ventilation

Corresponding Air Change Rate 0.11 1/h
(for window ventilation: at 1 K temperature difference indoor - outdoor)

Minimum Acceptable Indoor Temperature 22.0 °C

	Orientation of the Area	Angle Factor Summer		Shading Factor Summer		Dirt		g-Value (perp. radiation)		Area m²		Portion of Glazing		Aperture m²
1.	North	0.9	*	0.53	*	0.95	*	0.51	*	1.1	*	37%	=	0.1
2.	East	0.9	*	0.67	*	0.95	*	0.51	*	10.0	*	69%	=	2.0
3.	South	0.9	*	0.22	*	0.95	*	0.61	*	38.0	*	79%	=	3.5
4.	West	0.9	*	0.85	*	0.95	*	0.32	*	6.0	*	76%	=	1.1
5.	Horizontal	0.9	*	1.00	*	0.95	*	0.00	*	0.0	*	0%	=	0.0
6	Sum Opaque Areas													0.0

Solar Aperture Total 6.7 m² 0.03 m²/m²

Internal Heat Gains Q_I: Specif. Power q_I 2.10 W/m² * A_{TFA} 225 m² = 473 W 2.1 W/m²

Frequency of Overheating $h_{\vartheta \geq \vartheta max}$ **0.0%** at the overheating limit ϑ_{max} = 25 °C

If the "frequency over 25°C" exceeds 10%, additional measures to protect against summer heat waves are necessary.

Daily Temperature Swing due to Solar Load: Solar Load 19.2 kWh/d * 1000 1/k / (Spec. Capacity 132 Wh/(m²K) * A_{TFA} 225 m²) = **0.6 K**

Passive House verification

SUMMER VENTILATION

Building: Casa Tortuga

Building Type/Use: Residential

Building Volume: 563 m³

Description							
		S-1,16,E2,5,	S-17, N-1,3	S-3,6	E-1,8		
	Fraction of Opening Duration	25%	25%	25%	25%		
Climate Boundary Conditions							
	Temperature Diff Interior - Exterior	1	1	1	1		K
	Wind Velocity	0	0	0	0		m/s

Note: for summer night ventilation please set a temperature difference of 1 K and a wind velocity of 0 m/s otherwise the cooling effects of the night ventilation will be overestimated!

Window Group 1							
	Quantity	5	4	2	2		
	Clear Width	0.45	0.45	0.75	1.06		m
	Clear Height	1.06	0.45	1.06	1.06		m
	Tilting Windows?	x	x	x	x		
	Opening Width (for tilting windows)	0.150	0.150	0.150	0.150		m
Window Group 2 (Cross Ventilation)							
	Quantity						
	Clear Width						m
	Clear Height						m
	Tilting Windows?						
	Opening Width (for Tilting Windows)						m
	Difference in Height to Window 1						m

Single-Sided Ventilation 1 - Airflow Volume	108	31	51	56	0	0	m³/h
Single-Sided Ventilation 2 - Airflow Volume	0	0	0	0	0	0	m³/h
Cross Ventilation Airflow Volume	108	31	51	56	0	0	m³/h
Contribution to Air Change Rate	0.05	0.01	0.02	0.02	0.00	0.00	1/h

Summary of Summer Ventilation Distribution

Description Ventilation Type	Daily Average Air Change Rate	
Daytime	0.11	1/h
		1/h
		1/h

Passive House verification

HEAT DISTRIBUTION AND DHW SYSTEM

Building:	Casa Tortuga	
Interior Temperature:	20	°C
Building Type/Use:	Residential	
Treated Floor Area A_{TFA}:	225	m²
Occupancy:	6.4	Pers
Number of Residences:	1	
Annual Heating Demand qHeating	3389	kWh/a
Length of Heating Period:	223	d
Average heating load Pave:	0.6	kW
Marginal Utilisability of Additional Heat Gains:	74%	

				Parts					
				Warm Region	Cold Region		Total		
Space Heat Distribution				1	2	3			
Length of Distribution Pipes	L_H	*(Project)*						m	
Heat Loss Coefficient per m Pipe	Ψ	*(Project)*						W/(mK)	
Temperature of the Room Through Which the Pipes l	ϑ_X	*Mechanical Room*		20				°C	
Design Flow Temperature	ϑ_{dist}	*Flow, Design Value*						°C	
Design System heating load	$P_{heating}$	*(exist./calc.)*						kW	
Flow Temperature Control (check)									
Design Return Temperature	ϑ_R		=0.714*(ϑ_{dist}-20)+20					°C	
Annual Heat Emission per m of Plumbing	q^*_{HL}		= Ψ (ϑ_m−ϑ_X) $t_{Heating}$*0.024				Total 1,2,3	kWh/(m·a)	
Possible Utilization Factor of Released Heat	η_G							-	
Annual Losses	Q_{HL}		= L_H · q^*_{HL} · (1-η_G)	0	0	0	0	kWh/a	
Specif. Losses	q_{HL}		= ΣQ_{HL} / A_{TFA}					kWh/(m²a)	0.0
'Performance ratio of heat distribution	$e_{a,HL}$		= (q_H + q_{HL}) / q_H				100%	-	
DHW: Standard Useful Heat									
DHW Consumption per Person and Day (60 °C)	V_{DHW}	*(Project or Average Value 25 Litres/P/d)*					25.0	Litre/Person/d	
Average Cold Water Temperature of the Supply	ϑ_{DW}	*Temperature of Drinking Water (10°)*					7.0	°C	
DHW Non-Electric Wash and Dish		*(Electricity worksheet)*					0	kWh/a	
Useful Heat - DHW	Q_{DHW}						3609	kWh/a	
Specif. Useful Heat - DHW	q_{DHW}		= Q_{DHW} / A_{TFA}					kWh/(m²a)	16.0
DHW Distribution and Storage				Warm Region	Cold Region		Total		
Length of Circulation Pipes (Flow + Return)	L_{HS}	*(Project)*		0.0				m	
Heat Loss Coefficient per m Pipe	Ψ	*(Project)*		0.500				W/m/K	
Temperature of the Room Through Which the Pipes l	ϑ_X	*Mechanical Room*		20				°C	
Design Flow Temperature	ϑ_{dist}	*Flow, Design Value*		60.0				°C	
Daily circulation period of operation.	td_{Circ}	*(Project)*		0.0				h/d	
Design Return Temperature	ϑ_R		=0.875*(ϑ_{dist}-20)+20	55				°C	
Circulation period of operation per year	t_{Circ}		= 365 td_{Circ}	0				h/a	
Annual Heat Released per m of Pipe	q^*_Z		= Ψ (ϑ_m−ϑ_X) t_{Circ}	0				kWh/m/a	
Possible Utilization Factor of Released Heat	η_{GDHW}		=$t_{heating}$/365d * η_G	45%				-	
Annual Heat Loss from Circulation Lines	Q_Z		= L_{HS} · q^*_Z ·(1-η_{GDHW})	0			0	kWh/a	
Total Length of Individual Pipes	L_U	*(Project)*		50.00				m	
Exterior Pipe Diameter	d_{U_Pipe}	*(Project)*		0.019				m	
Heat loss per tap opening	$q_{Individual}$		=($c_{pH2O}$$V_{H2O}$+$c_{pMat}$$V_{Mat}$)($\vartheta_{dist}$-$\vartheta_X$)	0.5145				kWh/tap opening	
Amount of tap openings per year	n_{Tap}		= n_{Pers} . 3 . 365 / n_{LU}	7041				Tap openings per year	
Annual Heat Loss	q_U		= n_{Tap} . $q_{Individual}$	3623				kWh/a	
Possible Utilization Factor of Released Heat	η_{G_U}		=$t_{heating}$/8760*η_G	45%				-	
Annual Heat Loss of Individual Pipes	Q_U		= q_U ·(1-η_{G_U})	1983			1983	kWh/a	
							Total 1,2,3		
Average Heat Released From Storage	P_S			120				W	
Possible Utilization Factor of Released Heat	η_{G_S}		=$t_{heating}$/8760*η_G	45%					
Annual Heat Losses from Storage	Q_S		= P_S·8.760 kh·(1-η_{G_S})	575			575	kWh/a	
							Total 1,2,3		
Total Heat Losses of the DHW System	Q_{WL}		= Q_Z+Q_U+Q_S				2558	kWh/a	
Specif. Losses of the DHW System	q_{WL}		= Q_{WL} / A_{TFA}					kWh/(m²a)	11.4
Performance ratio DHW-distribution + storage	$e_{a,WL}$		= (q_{TWW} + q_{WV}) / q_{TWW}				170.9%	-	
Total Heating Demand of DHW system	Q_{gDHW}		= Q_{DHW}+Q_{WL}				6167	kWh/a	
Total Spec. Heating Demand of DHW System	q_{gDHW}		= Q_{gDHW} / A_{TFA}					kWh/(m²a)	27.4

Secondary Calculation: Ψ-Values of Plumbing

Nominal Width	19	mm
Insulation Thickness:	20	mm
Reflective? Please mark with an "x"!		
Yes	Please check one cell	
No		
Thermal Conductivity	0.04	W/(mK)
$\Delta\vartheta$	30	K
Interior Pipe Diameter:	0.01900	m
Exterior Pipe Diameter	0.02125	m
Exterior Pipe Diameter	0.06125	m
α–Surface		W/(m²K)
Ψ-Value		**W/(mK)**
Surface Temperature Difference		K

Passive House verification

ELECTRICITY DEMAND

Building: Casa Tortuga

# Households	1	HH
Persons	6.4	P
Living Area	225	m²
Annual Heating Demand	15	kWh/(m²a)

Solar Fraction of DHW Laundry&Dish	
Marginal Performance Ratio DHW	0%
Marginal Performance Ratio Heating	0%

Prim. Energy Factors:	Electricity	2.6	kWh/kWh
	Natural Gas	1.1	kWh/kWh
Energy Carrier for Space Heating/DHW:		2.6	2.6

Column Nr.	1	2	3		4		5		6		7		8	8a		9		10		11		12		13		14
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Frequency		Reference Quantity		Useful Energy (kWh/a)		Electric Fraction	Non-Electric Fraction		**Electricity Demand (kWh/a)**		Additional Demand		Marginal Performance Ratio		Solar Fraction		**Non-Electric Demand (kWh/a)**		**Primary Energy-Demand (kWh/a)**
Dishwashing	1	1	1.10	kWh/Use	* 1.00	*	65	/(P*a)	* 6.4	P =	460	*	100%		=	**460**										**1195**
Cold Water Connection												*	0%					* (1+ 0.30) *	0.00	*(1-		) =				
Clothes washing	1	1	1.10	kWh/Use	* **1.00**	*	57	/(P*a)	* 6.4	P =	403	*	100%		=	**403**										**1048**
Cold Water Connection												*	0%					* (1+ 0.05) *	0.00	*(1-		) =				
Clothes drying with:	1	1	3.50	kWh/Use	Residual dampness 0.60 0.88	*	57	/(P*a)	* 6.4	P =	1122	*	100%		=	**1122**										**2918**
Condensation Dryer										=	0		0%							1.00	*			**0**		**0**
Energy consumed by evaporation	0	1	3.13	kWh/Use	* 0.60	*	57	/(P*a)	* 6.4	P =	0	*	100%					* (1+ 0.00) *	0.00	*(1-	0.63	) =	**0**		**0**
Refrigerating	1	1	0.78	kWh/d	* 1.00	*	365	d/a	* 1	HH =	285	*	100%		=	**285**										**740**
Freezing	1	1	0.88	kWh/d	* 1.00	*	365	d/a	* 1	HH =	321	*	100%		=	**321**										**835**
or combined unit	0	1	1.00	kWh/d	* 1.00	*	365	d/a	* 1	HH =	0	*	100%		=	**0**										**0**
Cooking with:	1	1	0.25	kWh/Use	* 1.00	*	500	/(P*a)	* 6.4	P =	804	*	100%		=	**804**										**2090**
Electricity					Percentage CFLs							*	0%												**0**	**0**
Lighting	1	1	21	W	**80%** * 1.00	*	2.90	kh/(P*a)	* 6.4	P =	388	*	100%		=	**388**										**1008**
Consumer electronics	1	1	80	W	* 1.00	*	**0.55**	kh/(P*a)	* 6.4	P =	283	*	100%		=	**283**										**736**
Small appliances, etc.	1	1	50	kWh	* 1.00	*	1.00	/(P*a)	* 6.4	P =	322	*	100%		=	**322**										**836**
Total aux. electricity											1103					**1103**										**2867**
Other:																										
				kWh/a							0					**0**										**0**
				kWh/a							0					**0**										**0**
				kWh/a							0					**0**										**0**
Total											**5490**	**kWh**				**5490**	kWh	DHW Non-Electric - Wash&Dish	**0**		kWh		**0**		**14274**
Specific Demand																**24.4**	kWh/(m²a)	Non-Renewable Non-Electric DHW Wash&Dish	**0.0**		kWh/(m²a)		**0.0**		**63.4**
Recommended Maximum Value																**18**										**50**

Passive House verification

AUXILIARY ELECTRICITY

Building: Casa Tortuga

1	Living Area	225	m²
2	Heating Period	223	d
3	Air Volume	563	m³
4	Dwelling Units	1	HH
5	Enclosed Volume	752	m³

Operation Vent. System Winter	5.36	kh/a
Operation Vent. System Summer	3.40	kh/a
Air Change Rate	0.30	h^{-1}
Defrosting HX from	-5.0	°C

Primary Energy Factor - Electricity	2.6	kWh/kWh
Annual Space Heating Demand	15	kWh/(m²a)
Boiler Rated Power	15	kW
DHW System Heating Demand	6167	kWh/a
Design Flow Temperature	0	°C

Column Nr.	1	2	3		4		5		6		7	8	9	10	11
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Period of Operation		Reference Size		Electricity Demand (kWh/a)	Available as Interior Heat	Used During Time Period (kh/a)	Internal Heat Source (W)	Primary Energy Demand (kWh/a)
Ventilation System															
Winter Ventilation	1	1	0.31	Wh/m³ *	0.30	h^{-1} *	5.4	kh/a *	562.625	m³ =	281	considered in heat recovery efficiency			729
Summer Ventilation	1	1	0.31	Wh/m³ *	0.30	h^{-1} *	3.4	kh/a *	562.625	m³ =	178	no summer contribution to IHG			463
Defroster HX	1	1	326	W *	1.00	*	0.1	kh/a *	1	=	22	* 1.0	/ 5.36	= 4	57
Heating System				Controlled/Uncontrolled (1/0)											
Enter the Rated Power of the Pump				W	0										
Circulation Pump	1	1	116	W *	1.0	*	5.4	kh/a *	1	=	622	* 1.0	/ 5.36	= 116	1617
Boiler Electricity Consumption at 30% Load				W											
Aux. Energy - Heat. Boiler	0	0	55	W *	1.00	*	0.00	kh/a *	1	=	0	* 1.0	/ 5.36	= 0	0
Aux. Energy - Wood fired/pellet boiler	0	0	Data entries in worksheet Boiler. Auxiliary energy demand including possible drinking water produc								0	* 1.0	/ 5.36	= 0	0
DHW system															
Enter Average Power Consumption of Pump				W											
Circulation Pump	0	1	29	W *	1.00	*	5.0	kh/a *	1	=	0	* 0.6	/ 8.76	= 0	0
Enter the Rated Power of the Pump				W											
Storage Load Pump DHW	0	0	58	W *	1.00	*	0.4	kh/a *	1	=	0	* 1.0	/ 5.36	= 0	0
Boiler Electricity Consumption at 100% Load				W											
DHW Boiler Aux. Energy	0	0	165	W *	1.00	*	0.0	kh/a *	1	=	0	* 1.0	/ 5.36	= 0	0
Enter the Rated Power of the Solar DHW Pump				W											
Solar Aux Electricity	0	1	42	W *	1.00	*	1.8	kh/a *	1	=	0	* 0.6	/ 8.76	= 0	0
Misc. Aux. Electricity															
Misc. Aux. Electricity	0	0		kWh/a *	1.00	*	1.0	*	1	HH =	0	* 1.0	/ 8.76	= 0	0
Total											1103			120	2867
Specific Demand	kWh/(m²a)		Divide by Living Area:								4.9				12.7

Passive House verification

PRIMARY ENERGY VALUE

Building: Casa Tortuga

Building Type/Use: Residential

Treated Floor Area A_{TFA}: 225 m²

Space Heating Demand incl. Distribution: 15 kWh/(m²a)

Useful Cooling Demand: 0 kWh/(m²a)

			Final Energy kWh/(m²a)	Primary Energy kWh/(m²a)	Emissions CO_2-Equivalent kg/(m²a)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*		2.6	680
Direct Electric Heating	$Q_{H,de}$		0.0	0.0	0.0
DHW Production, Direct Electric (without Wash&Dish)	$Q_{DHW,de}$	*(DHW+Distribution, SolarDHW)*	0.0	0.0	0.0
Electric Post heating DHW Wash&Dish		*(Electricity, SolarDHW)*	0.0	0.0	0.0
Strombedarf Haushaltsgeräte	Q_{EHH}	*(Electricity worksheet)*	19.5	50.7	13.3
Electricity Demand - Auxiliary Electricity			4.9	12.7	3.3
Total Electricity Demand (without Heat Pump)			**24.4**	**63.4**	**16.6**
Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*		2.6	680
Energy Carrier - Supplementary Heating			Electricity	2.6	680
Annual Coefficient of Performance - Heat Pump		*Separate Calculation*			
Total System Performance Ratio of Heat Generator		*Separate Calculation*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}		0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0.0	0.0	0.0
Total Electricity Demand Heat Pump			**0.0**	**0.0**	**0.0**
Compact Heat Pump Unit				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*		2.6	680
Energy Carrier - Supplementary Heating			Electricity	2.6	680
COP Heat Pump Heating		*(Compact worksheet)*	0.0		
COP Heat Pump DHW		*(Compact worksheet)*	0.0		
Performance Ratio of Heat Generator (Verification)		*(Compact worksheet)*			
Performance Ratio of Heat Generator (Planning)		*(Compact worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(Compact worksheet)*	0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish			0.0	0.0	0.0
Total Compact Unit		*(Compact worksheet)*	**0.0**	**0.0**	**0.0**
HP Combination: 2 independent HP for heating and WW see "HP Combi" worksheet				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	100%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	100%	2.6	680
Energy Carrier - Supplementary Heating			Electricity	2.6	680
COP Heat Pump for Heating		*(Compact worksheet)*	3.8		
COP Heat Pump for DHW		*(Compact worksheet)*	4.3		
Performance Ratio of Heat Generator (Verification)		*(Compact worksheet)*	0.29		
Performance Ratio of Heat Generator (Planning)		*(Compact worksheet)*	0.29		
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(Compact worksheet)*	12.5	32.5	8.5
Non-Electric Demand, DHW Wash&Dish			0.0	0.0	0.0
Total Combined HP		*(Compact worksheet)*	**12.5**	**32.5**	**8.5**
Boiler				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*			
Boiler Type		*(Boiler worksheet)*			
Performance Ratio of Heat Generator		*(Boiler worksheet)*	0%		
Annual Energy Demand (without DHW Wash&Dish)		*(Boiler worksheet)*	0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0.0	0.0	0.0
Total Heating Oil/Gas/Wood			**0.0**	**0.0**	**0.0**
District Heat				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*		0.0	0
Heat Source		*(District Heat worksheet)*			
Performance Ratio of Heat Generator		*(District Heat worksheet)*	0%		
Heating Demand District Heat (without DHW Wash&Dish)		*(District Heat worksheet)*	0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish		*(Blatt Strom)*	0.0	0.0	0.0
Total District Heat			**0.0**	**0.0**	**0.0**
Other				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*		0.2	55
Heat Source		*(Project)*	Wood		
Performance Ratio of Heat Generator		*(Project)*			
Annual Energy Demand, Space Heating			0.0	0.0	0.0
Annual Energy Demand, DHW (without DHW Wash&Dish)			0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish		*(Blatt Strom)*	0.0	0.0	0.0
Non-Electric Demand Cooking/Drying (Gas)		*(Blatt Strom)*	0.0	0.0	0.0
Total - Other			**0.0**	**0.0**	**0.0**
Cooling with Electric Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
				kWh/kWh	g/kWh
Covered Fraction of Cooling Demand		*(Project)*	100%	2.6	680
Heat Source			Electricity		
Annual coefficient of performance cooling					
Energy Demand Space Cooling			**0.0**	**0.0**	**0.0**
Heating, Cooling, DHW, Auxiliary and Household Electricity			**36.9**	**95.9**	**25.1**
Total PE Value			**95.9** kWh/(m²a)		
Total Emissions CO_2-Equivalent			**25.1** kg/(m²a)		
		Primary Energy Requirement	**120** kWh/(m²a)		**yes** (Yes/No)
Heating, DHW, Auxiliary Electricity (No Household Applications)			**17.4**	**45.2**	**11.8**
Specific PE Demand - Mechanical System			**45.2** kWh/(m²a)		
Total Emissions CO_2-Equivalent			**11.8** kg/(m²a)		

Solar Electricity		kWh/a	PE Value (Savings)	CO_2-Emission Factor
Planned Annual Electricity Generation	*Separate Calculation*		kWh/kWh	g/kWh
			0.7	250
Specific Demand				
PE Value: Conservation by Solar Electricity		kWh/(m²a)		
Saved CO_2 emissions through solar electricity		kg/(m²a)		

Passive House verification

COMBINATION OF TWO SMALL EXHAUST AIR HEAT PUMP (HEATING AND WW-PRODUCTION) FOR PAS

(Calculation from Values Measured in the Laboratory Test for Unit Certification)

Building:	Casa Tortuga	Building Type/Use:	Residential	
		Treated Floor Area A_{TFA}:	225	m²

Covered Fraction of Space Heating Demand		*(PE Value worksheet)*	100%	
Space Heating Demand + Distribution Losses	Q_H+Q_{HL}:	*(DHW+Distribution)*	3389	kWh
Solar Fraction for Space Heat	$\eta_{Solar,\ H}$	*(Separate Calculation)*	0%	
Effective Annual Heating Demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		**3389**	kWh
Covered Fraction of DHW Demand		*(PE Value worksheet)*	100%	
Total Heating Demand of DHW system	Q_{gDHW}	*(DHW+Distribution)*	6167	kWh
Solar Fraction for DHW	$\eta_{Solar,\ DHW}$	*(SolarDHW worksheet)*	0%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		**6167**	kWh

Selection of Compact Unit (Data Inputs from Row 173): Magneron Heat Pump

Measured Values from Laboratory Test

Ventilation

Effective Heat Recovery Efficiency	η_{eff} *(Test Stand)*	78%	
Electric Efficiency	*(Test Stand)*	0.45	Wh/m³

Heating

		Test Point 1	*Test Point 2*	*Test Point 3*	*Test Point 4*	
Ambient Air Temperature	T_{amb}	8.3	-8.3	-25.0		°C
Measured Thermal Power Heat Pump Heating	$P_{HP,Heating}$	0.29	0.25	0.28		kW
Measured COP Heating	$COP_{Heating}$	4.90	2.90	1.80		-

DHW

		Test Point 1	*Test Point 2*	*Test Point 3*	*Test Point 4*	
Ambient Air Temperature	T_{amb}	8.3	-8.3	-25.0	20.0	°C
Measured Thermal Power DHW Storage Heating-Up	$P_{DHW,Heating-Up}$	0.29	0.25	0.28	0.29	kW
Measured Thermal Power DHW Storage Reload	$P_{DHW,Reload}$	0.29	0.25	0.28	0.29	kW
Measured COP DHW Storage Heating-Up	$COP_{DHW,Heating-Up}$	4.90	2.90	1.80	4.90	-
Measured COP DHW Storage Reload	$COP_{DHW,Reload}$	4.90	2.90	1.80	4.90	-

Standby (Inputs required only if different from storage reload)

		Test Point 1	*Test Point 2*	*Test Point 3*	*Test Point 4*	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Standby	$P_{HP,Standby}$					kW
Measured COP Standby	$COP_{Standby}$					-

Specific Heat Loss Storage incl. Connections	U * $A_{Storage}$	*(Test Stand)*	3.00	W/K
Average Storage Temperature in Standby Mode	$T_{DHW,Standby}$	*(Test Stand)*	0	°C
	Room Temperature (°C)		20	
	Av. Ambient Temp. Heating P. (°C)		-1	
	Av. Ground Temp (°C)		7	
Efficiency SHX Exhaust Air Mixing	$\eta*_{SHX}$		0%	
Heat Recovery Efficiency SHX Exhaust Air Mixing (if applicable)	$\eta_{SHX,add}$	*(Design Value)*	0%	
Volume Flow Rate of Added Exhaust Air (if applicable)	V_{add}	*(Test Stand)*	0	m³/h
Frost protection (see "Defrosting HX" in AuxElectricity sheet)	Hydraulic heating frost protection?			(hot gas or WW-circuit of HP)

Heat Supplied by Direct Electricity	$Q_{E,dir}$	753	kWh/a
Space Heat Supplied by HP	$Q_{HP,Heating}$	2814	kWh/a
Winter DHW Supplied by HP	$Q_{HP,DHW,Winter}$	2066	kWh/a
Winter Standby Heat Supplied by HP	$Q_{HP,Standby,Winter}$	-176	kWh/a
Summer DHW Supplied by HP	$Q_{HP,DHW,Summer}$	4101	kWh/a
Summer Standby Heat Supplied by HP	$Q_{HP,Standby,Summer}$	-350	kWh/a

Performance Ratio of Heat Generator, DHW & Space Heating			**29%**	
Annual Coefficient of Performance	**COP**		3.5	
			kWh/a	kWh/(m²a)
Final Energy Demand Heat Generation	Q_{final}		**2811**	**12.5**
Annual Primary Energy Demand			**7309**	**32.5**
			kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions			**1912**	**8.5**

incl. DHW Connection for Washing Machines & Dishwashers

6167	kWh
0%	

6167 kWh

753	kWh/a
2814	kWh/a
2066	kWh/a
-176	kWh/a
4101	kWh/a
-350	kWh/a

29%

kWh/a	kWh/(m²a)
2811	**12.5**
7309	**32.5**

kg/a	kg/(m²a)
1912	**8.5**

Passive House verification

CLIMATE DATA

Standard/Regional Climate: Select here.

Regional climate data

Select region here

Canada

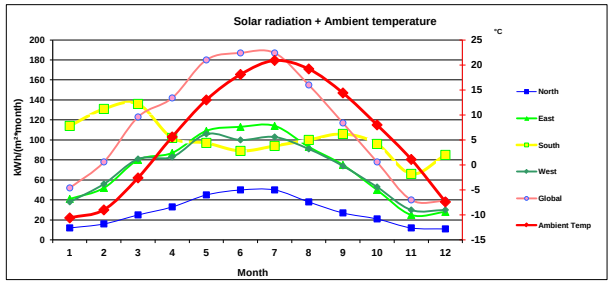
Select regional climate here:

Ottawa

Building:	Casa Tortuga	
Use Regional Data?	Yes	
Climate Building	Ottawa	
Chosen Method for Heating Demand:	Monthly method	
Monthly Data:	Ottawa	
Annual Data:		
Use Annual Climate Data Set	No	
Results:		
Annual Heating Demand	15.1	kWh/(m²a)
Heating Load	10.3	W/m²

Transfer to Annual Method

H_T	223	d/a
G_t	115	kKh/a
North	142	kWh/(m²a)
East	392	kWh/(m²a)
South	756	kWh/(m²a)
West	400	kWh/(m²a)
Horizontal	600	kWh/(m²a)



Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating Load		Cooling Load
Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2	Radiation
Ottawa	Latitude:	45.4	Longitude ° East	-75.7	Altitude m	62		Daily Temperature Swing Summer (K)		11.7	Radiation Data:	kWh/(m²*month)	Radiation: W/m²		W/m²
Ambient Temp	-10.6	-9.0	-2.6	5.6	13.0	18.1	20.9	19.2	14.4	8.0	1.1	-7.4	-19.4	-14.0	23.9
North	12	16	25	33	45	50	50	38	27	21	12	11	16	14	65
East	41	52	80	87	109	113	114	93	75	50	25	28	58	38	147
South	114	131	136	102	97	89	94	100	106	96	66	85	147	90	108
West	38	56	81	83	106	100	103	91	74	53	30	30	44	32	110
Global	52	78	123	142	180	187	187	155	117	78	40	39	67	47	212
Dew Point	-15.2	-14.2	-8.5	-2.1	4.9	11.1	14.1	13.6	9.6	3.2	-2.7	-11.0			
Sky Temp	-29.0	-27.4	-19.6	-9.8	-2.0	5.9	8.9	8.5	3.0	-3.7	-10.7	-23.2			14.1
Ground Temp	5.2	4.0	4.1	5.4	7.5	10.7	12.8	14.0	13.3	12.0	9.8	7.3	4.0	4.0	14.0

Parameters for PHPP Calculated Ground Temperatures:

Phase Shift Months	
2.00	
Damping	
-1.05	
Depth m	
3.32	
Shift of Average Temperature K	
1.60	

Certification Documentation