Passive House Verification

Building:	Martin Residence
Street:	
Postcode/City:	
Province/Country:	NZ-New Zealand
Building type:	Single Family Detached
Climate data set:	ud---02-NZ0003b-Christchurch
Climate zone:	4: Warm-temperate — Altitude of location: 16 m

Home owner / Client:	
Street:	
Postcode/City:	
Province/Country:	NZ-New Zealand

Architecture:	MCD Architecture
Street:	119e Montreal Street
Postcode/City:	8023 Christchurch
Province/Country:	NZ-New Zealand

Mechanical engineer:	Ethos Homes
Street:	257 Knowles Street
Postcode/City:	8052 Christchurch
Province/Country:	NZ-New Zealand

Energy consultancy:	Sustainable Engineering Ltd.
Street:	76 Virgina Rd
Postcode/City:	4500 Whanganui
Province/Country:	NZ-New Zealand

Certification:	Detail Green
Street:	
Postcode/City:	
Province/Country:	

Year of construction:		Interior temperature winter [°C]:	20.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.5
No. of occupants:	2.7	Specific capacity [Wh/K per m² TFA]:	60

Interior temp. summer [°C]:	25.0
IHG cooling case [W/m²]:	2.6
Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

The PHPP has not been filled completely; it is not valid as verification

						Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	121.8					
Space heating	Heating demand	kWh/(m²a)	15.76	≤		15	-	yes
	Heating load	W/m²	9.81	≤		-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤		-	-	-
	Cooling load	W/m²	-	≤		-	-	
	Frequency of overheating (> 25 °C)	%	6	≤		10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤		20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.4	≤		0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	86	≤		-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	37	≤		60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	20	≥		-	-	

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

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

Passive House Classic? yes

Task:	First name:	Surname:	Signature:
	Toby	Brooke	

Issued on:		City:

Project data imported from designPH 1.5.01 — PHPP9 display.code: 370700783_201015_ZAZNZ_en09

PHPP Check

Passive House with PHPP Version 9.6a

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

▼ Overview input errors

There are still 1 error message(s) in your PHPP.

Verification	-
Climate	-
U-Values	-
Areas	-
Ground	-
Components	-
Windows	-
Shading	-
Ventilation	-
Addl vent	-
SummVent	-
Cooling units	-
DHW+Distribution	-
SolarDHW	-
PV	-
Electricity	-
Use non-res	-
Electricity non-res	-
Aux Electricity	1 Error(s)
IHG	-
IHG non-res	-
PER	-
Compact	-
HP	-
HP Ground	-
Boiler	-
District Heating	-

▼ **Are results missing from 'Verification' worksheet? Possible causes can be found next**

▼ **The following information is based on the energy balance calculation entered**

▼ **Plausibility check**

			Comment:
Verification	-		
	-		
	-		
	-		
Climate	-		
U-Values	-		
	-		
Areas	Info: compactness of the building: 3.8 m² envelope area per m² of treated floor area		
	There are building components with a factor X. How was this factor calculated?		
	-		
	-		
	-		
	-		
	-		
	-		
	-		
	-		
	-		
	Average reduction factor of building elements: 70 %		
	-		
Ground	-		
	-		
	-		
	-		
	-		
	-		
	-		
Components	-		
	Glazing: a very low Ug value [W/(m²K)] has been entered:0		
	-		
	-		
	-		
	-		
	Will a curtain-wall system be installed? Have the thermal bridge values for the glass carriers been entered in the 'Components' AND in the 'Areas' worksheets?		
	-		
	-		
	-		

	-		
	The average window/door installation thermal bridge values for the overall project are relatively high. An optimisation potential still exists here.		
	-		
Windows	-		
Shading	North, East, South, West: is there any horizontal shading for these alignments? Trees, houses, mountains that are further away almost always have an influence as well.		
	-		
	Warning: reduction factor for shading in winter: minimum: 0% , maximal: 86% , average: 63%		
	Information: reduction factor for shading [%] in summer: average: 57%		
	Horizontal shading and wind protection coefficient ('Ventilation' worksheet) do not match.		
	-		
Ventilation	-		
	An excellent level of airtightness has been set. Is this correct?		
	-		
	Has the air volume for the pressure test been calculated correctly? Please check.		
	-		
	-		
	-		
	-		
	The electrical efficiency of the ventilation unit is very good.		
	-		
	Electrical or hydraulic frost protection has not been selected. How will frost protection of the heat exchanger be ensured?		
	-		
Addl vent	-		
	-		
	-		
	-		
Heating	-		
	-		
	-		
	-		
Heating load	-		
SummVent	-		
	-		
	-		
	-		
	-		
	-		
	-		
Cooling units	-		
Cooling load	-		
DHW+Distribution	-		
	-		
	-		
	-		
	-		
	-		
	-		

Electricity	-		
Electricity non-res	-		
	-		
	-		
	-		
Aux Electricity	A circulation pump for heating has not been entered.		
IHG non-res	-		
	-		

Climate data

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Selection of climate data

Country:	ud-User Data
Region:	All
1-Sortierung: Alphabetisch	
Climate data set:	ud---02-NZ0003b-Christchurch
Climate zone:	4: Warm-temperate

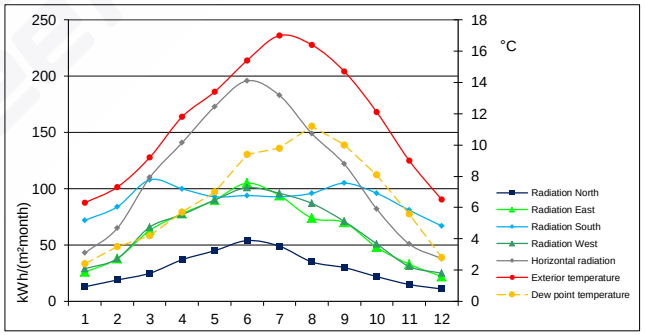
Altitude

Weather station:	34.0	m
Building location:	16	m

Result overview

Annual heating demand	15.8	kWh/(m²a)
Heating load	9.8	W/m²
Frequency of overheating	5.7	%
Sensible cooling	3.2	kWh/(m²a)
Latent cooling	0.0	kWh/(m²a)
Cooling load	-	W/m²
PER demand	37.4	kWh/(m²a)

	Data for heating Annual method	Data from monthly balance Heating	Cooling	
Heating / cooling period	190	365	365	d/a
Heating / cooling degree hours	55	79	-124	kKh/a
Radiation North	116	390	390	kWh/(m²a)
Radiation East	252	600	600	kWh/(m²a)
Radiation South	509	1072	1072	kWh/(m²a)
Radiation West	259	808	808	kWh/(m²a)
Horizontal radiation	433	1353	1353	kWh/(m²a)



	Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating load Weather 1	Heating load Weather 2	Cooling load Weather 1	Cooling load Weather 2	PER factors	
	Days	31	28	31	30	31	30	31	31	30	31	30	31						
	ud---02-NZ0003b-Christchurch	Latitude °	43.5	Longitude °	172.6	Altitude [m]	34	Daily temperature swing Summer [K]			9.3			Radiation: [W/m²]		Radiation: [W/m²]			
° C	Exterior temperature	6.3	7.3	9.2	11.8	13.4	15.4	17.0	16.4	14.7	12.1	9.0	6.5	1.9	4.6	22.7	22.5	1.15	Household electri
kWh/(m²month)	Radiation North	13	19	25	37	45	54	49	35	30	22	15	11	10	10	50	100	1.15	Domestic hot wat
kWh/(m²month)	Radiation East	26	38	63	78	90	105	94	74	70	48	33	22	35	10	180	225	1.10	Heating
kWh/(m²month)	Radiation South	72	84	108	100	93	94	93	96	105	96	81	67	110	20	220	195	1.00	Cooling
kWh/(m²month)	Radiation West	29	38	66	77	90	101	96	87	71	51	31	25	35	15	200	245	1.00	Dehumidification
kWh/(m²month)	Horizontal radiation	43	65	110	141	173	196	183	149	122	82	51	38	45	20	280	355		
° C	Dew point temperature	2.4	3.5	4.2	5.7	7.0	9.4	9.8	11.2	10.0	8.1	5.6	2.8			14.8	14.0		
° C	Sky temperature	-6.6	-4.7	-2.0	-0.6	0.9	5.0	5.3	6.3	4.9	0.8	-3.2	-6.0			11.6	14.0		
° C	Ground temperature	12.7	12.2	12.3	12.8	13.7	15.7	16.6	17.1	16.0	15.5	14.6	13.6	12.2	12.2	17.1	17.1		
	Comment:	Location is on the Southern Hemisphere. The original data has been adapted for use in the PHPP (see PHPP manual!). Source: Derived from Meteonorm & NIWA data.																	

U-value of building assemblies

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Secondary calculation: Equivalent thermal conductivity of still air spaces -> (on the right)
Wedge-shaped assembly layer -> (on the right)
Unheated / uncooled attic -> (on the right)

Assembly no.	Building assembly description	Interior insulation?
01ud	**Wall**	

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** — interior R_{si}: 0.13
Adjacent to: **3-Ventilated** — exterior R_{se}: 0.13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Ecoply Barrier	0.130					7
WoolpolyTerraLanaCeilingR3.6@140mm	0.039	Timber no dwangs	0.130			140
Intello						0
WoolpolyTerraLanaWallR1.2@45mm	0.038			Timber	0.130	45
GIB	0.250					10

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
82%	9.0%	9.0%	20.2 cm

U-value supplement: W/(m²K)

U-value: 0.224 W/(m²K)

Assembly no.		Interior insulation?
02ud	**Roof - vented**	

Heat transmission resistance [m²K/W]

Orientation of building element: **1-Roof** — interior R_{si}: 0.10
Adjacent to: **3-Ventilated** — 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]
Solitex1000						0
WoolpolyTerraLanaCeilingR4.0@180mm	0.045	Timber truss on 900 centres	0.130			360
WoolpolyTerraLanaCeilingR2.6@145mm	0.056					145
Intello						0
Air	0.210			Timber 70x35 batten	0.130	35
GIB	0.250					10

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
85%	6.0%	9.0%	55.0 cm

U-value supplement: W/(m²K)

U-value: 0.097 W/(m²K)

Assembly no.		Interior insulation?
03ud	**Slab**	

Heat transmission resistance [m²K/W]

Orientation of building element: **3-Floor** — interior R_{si}: 0.17
Adjacent to: **2-Ground** — 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]
EPSExpolThermaSlabS(S-grade)	0.038	concrete	2.100	Air	0.840	270
EPSExpolThermaSlabS(S-grade)	0.038	concrete	2.100			30
Concrete	2.100					100
XPSKnaufClimaFoamR1.8@50mm	0.028					100
Strandboard Overlay	0.130					20

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
30%	25.0%	45.0%	52.0 cm

U-value supplement [ ] W/(m²K)

U-value: 0.212 W/(m²K)

Assembly no. | Interior insulation?

04ud | **Thermadura Exterior Door**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0.13

Adjacent to: **1-Outdoor air** | 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]
Skin	**0.150**					**10**
Core	**0.033**	**Timber**	**0.150**			**32**
Skin	**0.150**					**10**

Percentage of sec. 1: 90% | Percentage of sec. 2: **10.0%** | Percentage of sec. 3: | Total: **5.1** cm

U-value supplement: W/(m²K)

U-value: 0.945 W/(m²K)

Assembly no. | Interior insulation?

05ud | **Slab in Bathroom 1, Utility room and Laundry**

Heat transmission resistance [m²K/W]

Orientation of building element: **3-Floor** | interior R_{si}: 0.17

Adjacent to: **2-Ground** | 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]
EPSExpolThermaSlabS(S-grade)	**0.038**	**concrete**	**2.100**	**Air**	**0.840**	**270**
EPSExpolThermaSlabS(S-grade)	**0.038**	**concrete**	**2.100**			**30**
Concrete	**2.100**					**100**
XPSKnaufClimaFoamR1.8@50mm	**0.028**	**Timber Joists on 450centres +5%**	**0.130**			**100**
Strandboard Overlay	**0.130**					**20**

Percentage of sec. 1: 40% | Percentage of sec. 2: **15.0%** | Percentage of sec. 3: **45.0%** | Total: **52.0** cm

U-value supplement: W/(m²K)

U-value: 0.289 W/(m²K)

Assembly no. | Interior insulation?

06ud

Heat transmission resistance [m²K/W]

Orientation of building element: | interior R_{si}:

Adjacent to: **0** | 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]

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K)

U-value: W/(m²K)

Assembly no. 07ud — Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element — interior R_{si}

Adjacent to 0 — 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]

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total cm

U-value supplement W/(m²K) — **U-value:** W/(m²K)

Assembly no. 08ud — Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element — interior R_{si}

Adjacent to 0 — 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]

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total cm

U-value supplement W/(m²K) — **U-value:** W/(m²K)

Assembly no. 09ud — Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element — interior R_{si}

Adjacent to 0 — 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]

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total cm

U-value supplement W/(m²K) — **U-value:** W/(m²K)

Assembly no. 10ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 11ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 12ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 13ud | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element | interior R_{si}

Adjacent to 0 | 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]

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: cm

U-value supplement: W/(m²K) | **U-value:** W/(m²K)

Assembly no. 14ud | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element | interior R_{si}

Adjacent to 0 | 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]

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: cm

U-value supplement: W/(m²K) | **U-value:** W/(m²K)

Assembly no. 15ud | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element | interior R_{si}

Adjacent to 0 | 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]

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: cm

U-value supplement: W/(m²K) | **U-value:** W/(m²K)

Assembly no. 16ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 17ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 18ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 19ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

Assembly no. 20ud

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element

Adjacent to 0

interior R_{si}

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]

Percentage of sec. 1: 100%

Percentage of sec. 2

Percentage of sec. 3

Total cm

U-value supplement W/(m²K)

U-value: W/(m²K)

U-value of building assemblies

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Auxiliary calculation: equivalent thermal conductivity for still air layers

Thickness of air layer	190	mm	Convective heat exchange		
Direction of heat flow:		Upward	h_a	0.249189	W/(m²K)
		Horizontal	Radiation heat transfer		
	x	Downward	h_r	4.17	W/(m²K)
Coefficient of emission surface 1	0.90		Equivalent thermal conductivity		
Coefficient of emission surface 2	0.90		λ	0.84	W/(mK)

Thickness of air layer		mm	Convective heat exchange		
Direction of heat flow:		Upward	h_a		W/(m²K)
		Horizontal	Radiation heat transfer		
		Downward	h_r		W/(m²K)
Coefficient of emission surface 1			Equivalent thermal conductivity		
Coefficient of emission surface 2			λ		W/(mK)

Wedge shaped assembly layer (with an inclination of max. 5%)

(Calculation according to EN 6946 Annex C)

Building assembly description	
01kf	

Heat transmission resistance [m²K/W]

Orientation of building element		interior R_{si}	
Adjacent to		exterior R_{se} :	

A parallel building assembly layers

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Total width Thickness t_0 [mm]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U_0:		W/(m²K)
R_0:		(m²K)/W

B wedge-shaped building assembly

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness t_1 [mm]

Percentage of sec. 2	Percentage of sec. 3	Thickness t_1 [cm]
		cm

U_1:		W/(m²K)
R_1:		(m²K)/W
U-value rectangular area:		W/(m²K)
U-value of triangular area with the thickest point at the apex:		W/(m²K)
U-value of triangular area with the thickest point at the apex:		W/(m²K)

Wedge shaped assembly layer (with an inclination of max. 5%)

(Calculation according to EN 6946 Annex C)

Building assembly description	
02kf	

Heat transmission resistance [m²K/W]

Orientation of building element		interior Rsi	
Adjacent to		exterior Rse :	

A parallel building assembly layers

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Total width Thickness t0 [mm]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U_0:		W/(m²K)
R_0:		(m²K)/W

B wedge-shaped building assembly

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness t1 [mm]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Thickness t1 [cm]
100%			cm

U_1:		W/(m²K)
R_1:		(m²K)/W
U-value rectangular area:		W/(m²K)
U-value of triangular area with the thickest point at the apex:		W/(m²K)
U-value of triangular area with the thickest point at the apex:		W/(m²K)

Unheated / uncooled attic

Building assembly description

Roof

Heat transmission resistance [m²K/W] interior R_{si} 0.10

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]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U-value supplement W/(m²K)

U-value: ##### W/(m²K)

Building assembly description

External wall attic

Heat transmission resistance [m²K/W] interior R_{si} 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]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U-value supplement W/(m²K)

U-value: ##### W/(m²K)

Building assembly description

Suspended ceiling

Heat transmission resistance [m²K/W] interior R_{si} 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]

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U-value supplement W/(m²K)

U-value: ##### W/(m²K)

Areas attic

Flat roof [m²]	
Area external wall attic [m²]	
Area intermediate floor [m²]	

Average radiation properties of exterior surfaces

Coefficient of absorption exterior	
Coefficient of emission exterior	

Air exchange in attic

Air change rate		1/h
Volume		m³

Coefficient of emission in roof

Interior side roof / external wall	
Top floor ceiling	

Equivalent specific values for the intermediate ceiling (link with 'Components' and 'Areas' worksheet)

U-Value [W/(m²K)]: **Absorption:** **Emissivity:**

Total energy transmittance (informative):

Areas determination

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment		Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]	Radiation-load cooling period [kWh/a]
									12 Months	12 Months
	Treated floor area	1	**121.75**	m²	*Treated floor area according to PHPP manual*					
A	**North windows**	2	**4.13**	m²			**North windows**	**1.055**	**284**	**296**
A	**East windows**	3	**3.49**	m²	Results come from the 'Windows' worksheet.		**East windows**	**1.042**	**325**	**358**
A	**South windows**	4	**17.34**	m²	Window areas are subtracted from individual opaque areas.		**South windows**	**0.860**	**3812**	**3469**
A	**West windows**	5	**4.14**	m²	which is displayed in the 'Windows' worksheet.		**West windows**	**1.108**	**139**	**162**
A	**Horizontal windows**	6	**0.00**	m²			**Horizontal windows**			
A	**Exterior door**	7	**0.00**	m²	*Please subtract area of door from respective building assembly*		**Exterior door**			
A	**External wall - Ambient**	8	**131.84**	m²	*Temperature zone "A" is ambient air*		**External wall - Ambient**	**0.224**	**122**	**125**
B	**External wall - Ground**	9	**0.00**	m²	*Temperature zone "B" is the ground*		**External wall - Ground**			
A	**Roof/Ceiling - Ambient**	10	**138.57**	m²			**Roof/Ceiling - Ambient**	**0.097**	**377**	**377**
B	**Floor slab / Basement ceiling**	11	**138.57**	m²			**Floor slab / Basement ceiling**	**0.218**		
		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				
X	**Garage Walls**	14	**23.46**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*	**97%**	**Garage Walls**	**0.292**		
							Thermal bridges - Overview	**Ψ [W/(mK)]**		
A	**Thermal bridges Ambient**	15	**0.00**	m	*Units in m*		**Thermal bridges Ambient**			
P	**Perimeter thermal bridges**	16	**78.80**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*		**Perimeter thermal bridges**	**-0.104**		
B	**Thermal bridges FS/BC**	17	**18.76**	m	*Units in m*		**Thermal bridges FS/BC**	**0.067**		
I	**Building element towards neigh**	18	**0.00**	m²	*No heat losses, only considered for the heating load calculation*		**Building element towards neighbour**			
Total thermal envelope			**461.52**	**m²**			**Average therm. envelope**	**0.218**		

Go to building components list

Area input

2-Sorting: BY ID

Area no.	Building assembly description	To group No.	Assigned to group	Quan-tity	x (	a [m]	x	b [m]	+	User deter-mined [m²]	-	User sub-traction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection building assembly / Building system	U-Value [W/(m²K)]	Deviation from North	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
	Projected building footprint	**0**	Projected building footprint	**1**	x (		x		+	**138.57**	-		)		=	138.6									
	Treated floor area	**1**	Treated floor area	**1**	x (		x		+	**121.75**	-		)		=	121.8									
	Exterior door	**7**	Exterior door		x (		x		+		-		)	-	=		Exterior door								
1	**FL01**	**11**	Floor slab / Basement ceiling	**1**	x (		x		+	**138.57**	-	**12.00**	)	- **0.0**	=	126.6	**03ud-Slab**	**0.212**	**91**	**180**	**Hor**			
2	**Garage Door**	**14**	Garage Walls	**1**	x (	**2.22**	x	**1.00**	+		-		)	- **0.0**	=	2.2	**04ud-Thermadura Exterior Door**	**0.945**						
3	**0.0**	**8**	External wall - Ambient	**1**	x (	**11.76**	x	**3.57**	+		-		)	- **10.3**	=	31.6	**01ud-Wall**	**0.224**	**158**	**90**	**South**	**0.70**	**0.50**	**0.90**
4	**WL04**	**8**	External wall - Ambient	**1**	x (	**9.66**	x	**3.57**	+		-		)	- **3.5**	=	31.0	**01ud-Wall**	**0.224**	**68**	**90**	**East**	**0.70**	**0.50**	**0.90**
5	**WL05**	**8**	External wall - Ambient	**1**	x (	**15.32**	x	**3.57**	+		-		)	- **4.1**	=	50.6	**01ud-Wall**	**0.224**	**-22**	**90**	**North**	**0.70**	**0.50**	**0.90**
6	**WL06**	**8**	External wall - Ambient	**1**	x (	**3.57**	x	**1.80**	+		-		)	- **2.1**	=	4.4	**01ud-Wall**	**0.224**	**-84**	**90**	**West**	**0.70**	**0.50**	**0.90**
7	**WL02**	**8**	External wall - Ambient	**1**	x (	**3.57**	x	**1.37**	+		-		)	- **2.1**	=	2.8	**01ud-Wall**	**0.224**	**-112**	**90**	**West**	**0.70**	**0.50**	**0.90**
8	**WLG01**	**14**	Garage Walls	**1**	x (	**3.57**	x	**2.55**	+		-	**2.22**	)	- **0.0**	=	6.9	**01ud-Wall**	**0.224**	**-174**	**90**	**South**			
9	**WL01**	**8**	External wall - Ambient	**1**	x (	**4.54**	x	**3.72**	+		-		)	- **7.0**	=	9.9	**01ud-Wall**	**0.224**	**-174**	**90**	**South**	**0.70**	**0.50**	**0.90**
10	**WLG02**	**14**	Garage Walls	**1**	x (		x		+	**14.37**	-		)	- **0.0**	=	14.4	**01ud-Wall**	**0.224**	**-84**	**90**	**West**			
11	**RF01**	**10**	Roof/Ceiling - Ambient	**1**	x (		x		+	**112.83**	-		)	- **0.0**	=	112.8	**02ud-Roof - vented**	**0.097**	**91**	**0**	**Hor**	**0.70**	**0.94**	**0.90**
12	**WL08**	**8**	External wall - Ambient	**1**	x (	**4.54**	x	**0.15**	+		-		)	- **0.0**	=	0.7	**01ud-Wall**	**0.224**	**6**	**90**	**North**	**0.70**	**0.50**	**0.90**
13	**WL07**	**8**	External wall - Ambient	**1**	x (	**5.67**	x	**0.15**	+		-		)	- **0.0**	=	0.9	**01ud-Wall**	**0.224**	**96**	**90**	**East**	**0.70**	**0.50**	**0.90**
14	**RF02**	**10**	Roof/Ceiling - Ambient	**1**	x (	**5.67**	x	**4.54**	+		-		)	- **0.0**	=	25.7	**02ud-Roof - vented**	**0.097**	**91**	**0**	**Hor**	**0.70**	**0.80**	**0.90**
15	**Bathroom floor**	**11**	Floor slab / Basement ceiling	**1**	x (		x		+	**12.00**	-		)	- **0.0**	=	12.0	**05ud-Slab in Bathroom area**	**0.289**	**91**	**180**	**Hor**			
16	-				x (		x		+		-		)	- **0.0**	=									
17	-				x (		x		+		-		)	- **0.0**	=									
18	-				x (		x		+		-		)	- **0.0**	=									
19	-				x (		x		+		-		)	- **0.0**	=									
20	-				x (		x		+		-		)	- **0.0**	=									
21	-				x (		x		+		-		)	- **0.0**	=									
22	-				x (		x		+		-		)	- **0.0**	=									
23	-				x (		x		+		-		)	- **0.0**	=									
24	-				x (		x		+		-		)	- **0.0**	=									
25	-				x (		x		+		-		)	- **0.0**	=									
26	-				x (		x		+		-		)	- **0.0**	=									
27	-				x (		x		+		-		)	- **0.0**	=									
28	-				x (		x		+		-		)	- **0.0**	=									
29	-				x (		x		+		-		)	- **0.0**	=									
30	-				x (		x		+		-		)	- **0.0**	=									
31	-				x (		x		+		-		)	- **0.0**	=									
32	-				x (		x		+		-		)	- **0.0**	=									
33	-				x (		x		+		-		)	- **0.0**	=									
34	-				x (		x		+		-		)	- **0.0**	=									
35	-				x (		x		+		-		)	- **0.0**	=									
36	-				x (		x		+		-		)	- **0.0**	=									
37	-				x (		x		+		-		)	- **0.0**	=									

Areas determination

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment		Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]	Radiation-load cooling period [kWh/a]
									12 Months	12 Months
	Treated floor area	1	**121.75**	m²	*Treated floor area according to PHPP manual*					
A	**North windows**	2	**4.13**	m²			**North windows**	**1.055**	**284**	**296**
A	**East windows**	3	**3.49**	m²	Results come from the 'Windows' worksheet.		**East windows**	**1.042**	**325**	**358**
A	**South windows**	4	**17.34**	m²	Window areas are subtracted from individual opaque areas.		**South windows**	**0.860**	**3812**	**3469**
A	**West windows**	5	**4.14**	m²	which is displayed in the 'Windows' worksheet.		**West windows**	**1.108**	**139**	**162**
A	**Horizontal windows**	6	**0.00**	m²			**Horizontal windows**			
A	**Exterior door**	7	**0.00**	m²	*Please subtract area of door from respective building assembly*		**Exterior door**			
A	**External wall - Ambient**	8	**131.84**	m²	*Temperature zone "A" is ambient air*		**External wall - Ambient**	**0.224**	**122**	**125**
B	**External wall - Ground**	9	**0.00**	m²	*Temperature zone "B" is the ground*		**External wall - Ground**			
A	**Roof/Ceiling - Ambient**	10	**138.57**	m²			**Roof/Ceiling - Ambient**	**0.097**	**377**	**377**
B	**Floor slab / Basement ceiling**	11	**138.57**	m²			**Floor slab / Basement ceiling**	**0.218**		
		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				
X	**Garage Walls**	14	**23.46**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*	**97%**	**Garage Walls**	**0.292**		
							Thermal bridges - Overview	**Ψ [W/(mK)]**		
A	**Thermal bridges Ambient**	15	**0.00**	m	*Units in m*		**Thermal bridges Ambient**			
P	**Perimeter thermal bridges**	16	**78.80**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*		**Perimeter thermal bridges**	**-0.104**		
B	**Thermal bridges FS/BC**	17	**18.76**	m	*Units in m*		**Thermal bridges FS/BC**	**0.067**		
I	**Building element towards neigh**	18	**0.00**	m²	*No heat losses, only considered for the heating load calculation*		**Building element towards neighbour**			
Total thermal envelope			**461.52**	**m²**			**Average therm. envelope**	**0.218**		

Go to building components list

38	-				x (		x		+		-		) -	0.0	=										
39	-				x (		x		+		-		) -	0.0	=										
40	-				x (		x		+		-		) -	0.0	=										
41	-				x (		x		+		-		) -	0.0	=										
42	-				x (		x		+		-		) -	0.0	=										
43	-				x (		x		+		-		) -	0.0	=										
44	-				x (		x		+		-		) -	0.0	=										
45	-				x (		x		+		-		) -	0.0	=										
46	-				x (		x		+		-		) -	0.0	=										
47	-				x (		x		+		-		) -	0.0	=										
48	-				x (		x		+		-		) -	0.0	=										
49	-				x (		x		+		-		) -	0.0	=										
50	-				x (		x		+		-		) -	0.0	=										

Aend

Areas determination

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment		Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]
	Treated floor area	1	**121.75**	m²	*Treated floor area according to PHPP manual*				12 Months
A	**North windows**	2	**4.13**	m²			**North windows**	**1.055**	**284**
A	**East windows**	3	**3.49**	m²	Results come from the 'Windows' worksheet.		**East windows**	**1.042**	**325**
A	**South windows**	4	**17.34**	m²	Window areas are subtracted from individual opaque areas.		**South windows**	**0.860**	**3812**
A	**West windows**	5	**4.14**	m²	which is displayed in the 'Windows' worksheet.		**West windows**	**1.108**	**139**
A	**Horizontal windows**	6	**0.00**	m²			**Horizontal windows**		
A	**Exterior door**	7	**0.00**	m²	*Please subtract area of door from respective building assembly*		**Exterior door**		
A	**External wall - Ambient**	8	**131.84**	m²	*Temperature zone "A" is ambient air*		**External wall - Ambient**	**0.224**	**122**
B	**External wall - Ground**	9	**0.00**	m²	*Temperature zone "B" is the ground*		**External wall - Ground**		
A	**Roof/Ceiling - Ambient**	10	**138.57**	m²			**Roof/Ceiling - Ambient**	**0.097**	**377**
B	**Floor slab / Basement ceiling**	11	**138.57**	m²			**Floor slab / Basement ceiling**	**0.218**	
		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			
X	**Garage Walls**	14	**23.46**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*	**97%**	**Garage Walls**	**0.292**	
							Thermal bridges - Overview	**Ψ [W/(mK)]**	
A	**Thermal bridges Ambient**	15	**0.00**	m	*Units in m*		**Thermal bridges Ambient**		
P	**Perimeter thermal bridges**	16	**78.80**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*		**Perimeter thermal bridges**	**-0.104**	
B	**Thermal bridges FS/BC**	17	**18.76**	m	*Units in m*		**Thermal bridges FS/BC**	**0.067**	
I	**Building element towards neigh**	18	**0.00**	m²	*No heat losses, only considered for the heating load calculation*		**Building element towards neighbour**		
Total thermal envelope			**461.52**	**m²**			**Average therm. envelope**	**0.218**	

Go to building components list

Thermal bridge inputs

Sortierung ändern

No.	Thermal bridge - denomination	Group No.	Assigned to group	Quantity	x (	Length [m]	-	Subtraction length [m]	)=	Length ℓ [m]	User determined psi value [W/(mK)]	User determined $f_{Rsi=0,25}$ (optional)	or	Selection building system	Ψ-Value [W/(mK)]	f_{Rsi}-Requirement met?
1	**Slab Edge ThermalBridge**	**16**	Perimeter thermal bridges	**1**	x (	**50.80**	-		) =	50.80	**-0.102**		or		**-0.102**	
2	**Roof Edge Long sides**	**16**	Perimeter thermal bridges	**1**	x (	**28.00**	-		) =	28.00	**-0.108**		or		**-0.108**	
3	**Structural walls to slab**	**17**	Thermal bridges FS/BC	**1**	x (	**18.76**	-		) =	18.76	**0.067**		or		**0.067**	
4					x (		-		) =				or			
5	-				x (		-		) =				or			
6	-				x (		-		) =				or			
7	-				x (		-		) =				or			
8	-				x (		-		) =				or			
9	-				x (		-		) =				or			
10	-				x (		-		) =				or			
11	-				x (		-		) =				or			
12	-				x (		-		) =				or			
13	-				x (		-		) =				or			
14	-				x (		-		) =				or			
15	-				x (		-		) =				or			
16	-				x (		-		) =				or			
17	-				x (		-		) =				or			
18	-				x (		-		) =				or			
19	-				x (		-		) =				or			
20	-				x (		-		) =				or			
21	-				x (		-		) =				or			
22	-				x (		-		) =				or			
23	-				x (		-		) =				or			
24	-				x (		-		) =				or			
25	-				x (		-		) =				or			
26	-				x (		-		) =				or			
27	-				x (		-		) =				or			
28	-				x (		-		) =				or			
29	-				x (		-		) =				or			
30	-				x (		-		) =				or			
31	-				x (		-		) =				or			
32	-				x (		-		) =				or			
33	-				x (		-		) =				or			
34	-				x (		-		) =				or			
35	-				x (		-		) =				or			
36	-				x (		-		) =				or			
37	-				x (		-		) =				or			
38	-				x (		-		) =				or			
39	-				x (		-		) =				or			
40	-				x (		-		) =				or			

Areas determination

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment		Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]
	Treated floor area	1	**121.75**	m²	*Treated floor area according to PHPP manual*				12 Months
A	**North windows**	2	**4.13**	m²			**North windows**	**1.055**	**284**
A	**East windows**	3	**3.49**	m²	Results come from the 'Windows' worksheet.		**East windows**	**1.042**	**325**
A	**South windows**	4	**17.34**	m²	Window areas are subtracted from individual opaque areas.		**South windows**	**0.860**	**3812**
A	**West windows**	5	**4.14**	m²	which is displayed in the 'Windows' worksheet.		**West windows**	**1.108**	**139**
A	**Horizontal windows**	6	**0.00**	m²			**Horizontal windows**		
A	**Exterior door**	7	**0.00**	m²	*Please subtract area of door from respective building assembly*		**Exterior door**		
A	**External wall - Ambient**	8	**131.84**	m²	*Temperature zone "A" is ambient air*		**External wall - Ambient**	**0.224**	**122**
B	**External wall - Ground**	9	**0.00**	m²	*Temperature zone "B" is the ground*		**External wall - Ground**		
A	**Roof/Ceiling - Ambient**	10	**138.57**	m²			**Roof/Ceiling - Ambient**	**0.097**	**377**
B	**Floor slab / Basement ceiling**	11	**138.57**	m²			**Floor slab / Basement ceiling**	**0.218**	
		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			
X	**Garage Walls**	14	**23.46**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*	**97%**	**Garage Walls**	**0.292**	
							Thermal bridges - Overview	**Ψ [W/(mK)]**	
A	**Thermal bridges Ambient**	15	**0.00**	m	*Units in m*		**Thermal bridges Ambient**		
P	**Perimeter thermal bridges**	16	**78.80**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*		**Perimeter thermal bridges**	**-0.104**	
B	**Thermal bridges FS/BC**	17	**18.76**	m	*Units in m*		**Thermal bridges FS/BC**	**0.067**	
I	**Building element towards neigh**	18	**0.00**	m²	*No heat losses, only considered for the heating load calculation*		**Building element towards neighbour**		
Total thermal envelope			**461.52**	**m²**			**Average therm. envelope**	**0.218**	

Go to building components list

41	-				x (		-		) =							or		
42	-				x (		-		) =							or		
43	-				x (		-		) =							or		
44	-				x (		-		) =							or		
45	-				x (		-		) =							or		
46	-				x (		-		) =							or		
47	-				x (		-		) =							or		
48	-				x (		-		) =							or		
49	-				x (		-		) =							or		
50	-				x (		-		) =							or		
TBend																		

Heat losses through the ground

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Building section 1

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			
Avg indoor temp. winter	T_i	20.0	°C
Avg indoor temp. summer	T_i	25.0	°C
Avg ground surface temperature	$T_{g,ave}$	12.6	°C
Amplitude of $T_{g,ave}$	$T_{g,^\wedge}$	5.4	°C
Phase shifting of $T_{e,m}$	τ	1.1	Months
Length of the heating period	n	6.3	Months
Heating degree hours - exterior	G_t	55.0	kKh/a

Building data							
Area of ground floor slab / basement	A	138.6	m²	U-value floor slab/basement ceiling	U_f	0.218	W/(m²K)
Perimeter length	P	50.8	m	TBs floor slab / basement ceiling	Ψ_B*l		W/K
Charact. dimension of floor slab	B'	5.46	m	U-value floor slab / basement ceiling i	U_f'	0.218	W/(m²K)
				Equivalent thickness floor	d_t	9.16	m

Floor slab type (select only one)

x	**Slab on grade**						
	Perimeter insulation width/depth	D		m	Orientation of perimeter insulation	horizontal	x
	Perimeter insulation thickness	d_n		m	(check only one field)	vertical	
	Conductivity perimeter insulation	λ_n		W/(mK)			
	Heated basement or floor slab completely / partially below ground level						
	Basement wall height below ground le	z		m	U-Value wall below ground	U_{wB}	W/(m²K)
	Unheated basement						
	Height aboveground wall	h		m	U-Value wall above ground	U_W	W/(m²K)
	Basement wall height below ground le	z		m	U-Value wall below ground	U_{WB}	W/(m²K)
	Air change unheated basement	n	0.20	h^{-1}	U-Value basement floor slab	U_{fB}	W/(m²K)
	Air volume basement	V		m³			
	Suspended floor above a ventilated crawl space (at max. 0.5 m below ground)						
	U-Value crawl space	U_{Crawl}		W/(m²K)	Area of ventilation openings	εP	m²
	Height of crawl space wall	h		m	Wind velocity at 10 m height	v	4.0 m/s
	U-Value crawl space wall	U_W		W/(m²K)	Wind shield factor	f_W	0.05 -

Additional thermal bridge heat losses at perimeter							
				Steady-state fraction	$\Psi_{P,stat}$*l		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	Groundwater correction factor	G_w	1.0065164	-
Groundwater flow rate	q_w	0.05	m/d				

Interim results

Phase shift	β	1.38	Months	Steady-state heat flow	Φ_{stat}	177.2	W
Steady-state transmittance	L_S	23.95	W/K	Periodic heat flow	Φ_{harm}	27.4	W
Exterior periodic transmittance	L_{pe}	11.17	W/K	Heat losses during heating period	Q_{tot}	934	kWh
Transmittance building	L_0	30.27	W/K				

Monthly average temperatures in the ground for monthly method (building assembly 1)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Avg. value
Winter	12.7	12.2	12.3	12.8	13.7	14.7	15.6	16.1	16.0	15.5	14.6	13.6	14.1
Summer	13.8	13.3	13.3	13.8	14.7	15.7	16.6	17.1	17.1	16.6	15.7	14.6	15.2

Design ground temperature for 'Heating load' worksheet 12.2 — **For 'Cooling load' worksheet** 17.1

Reduction factor for 'Annual heating' worksheet 0.56

Total result (all building parts)

Phase shift	β	1.38	Months	Steady-state heat flow	Φ_{stat}	177.2	W
Steady-state transmittance	L_S	23.95	W/K	Periodic heat flow	Φ_{harm}	27.4	W
Exterior periodic transmittance	L_{pe}	11.17	W/K	Heat losses during heating period	Q_{tot}	934	kWh
Transmittance building	L_0	30.27	W/K	Charact. dimension of floor slab	B'	5.46	m

Monthly Average temperatures in the ground for monthly method (all building assemblies)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Avg. value
Winter	12.7	12.2	12.3	12.8	13.7	14.7	15.6	16.1	16.0	15.5	14.6	13.6	14.1
Summer	13.8	13.3	13.3	13.8	14.7	15.7	16.6	17.1	17.1	16.6	15.7	14.6	15.2

Design ground temperature for 'Heating load' worksheet 12.2 — **For 'Cooling load' worksheet** 17.1

Reduction factor for 'Annual heating' worksheet 0.56

Passive House Components

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Go to: 'AREAS'
Thermal bridges (Psi-values)
Glazing
Window frames
www.passivehouse.com/component-database
Ventilation units
Compact units
Heat recovery DHW

Building assemblies (U-Values)

Recommended starting values for optimisation: U-values for walls and roofs | Floor slabs: 0.3 W/(m²K) | 0.32 W/(m²K)

		1			
ID	Building system	Building assembly	Total thickness	U-Value	Interior insulation
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
01ud	Wall	Wall	0.202	0.224	0
02ud	Roof - vented	Roof - vented	0.550	0.097	0
03ud	Slab	Slab	0.520	0.212	0
04ud	Thermadura Exterior Door	Thermadura Exterior Door	0.051	0.945	0
05ud	Slab in Bathroom 1, Utility room and Laundry	Slab in Bathroom 1, Utility room and Laundry	0.520	0.289	0
06ud					
07ud					
08ud					
09ud					
10ud					
11ud					
12ud					
13ud					
14ud					
15ud					
16ud					
17ud					
18ud					
19ud					
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52ud					
53ud					
54ud					
55ud					
56ud					
57ud					
58ud					

Building assemblies (U-Values)

Recommended starting values for optimisation: U-values for walls and roofs | Floor slabs: 0.3 W/(m²K) | 0.32 W/(m²K)

		1			
ID	Building system	Building assembly	Total thickness	U-Value	Interior insulation
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
59ud					
60ud					
61ud					
62ud					
63ud					
64ud					
65ud					
66ud					
67ud					
68ud					
69ud					
70ud					
71ud					
72ud					
73ud					
74ud					
75ud					
76ud					
77ud					
78ud					
79ud					
80ud					
81ud					
82ud					
83ud	PH External wall	PH External wall	0.460	0.150	0
84ud	PH Roof	PH Roof	0.460	0.150	0
85ud	PH Floor	PH Floor	0.410	0.250	0
86ud	PH Basement wall	PH Basement wall	0.410	0.250	0
87ud	Partition wall to neighbour	Partition wall to neighbour	0.410	0.250	0
88ud	Wall to zone X	Wall to zone X	0.460	0.150	0
89ud	PH External Door	PH External Door	0.050	0.500	0
90ud			0.000	0.000	0
91ud			0.000	0.000	0
92ud			0.000	0.000	0
93ud	Extg-Honeycomb (perforated) brick 24cm	Extg-Honeycomb (perforated) brick 24cm	0.275	1.440	0
94ud	Extg-Solid Brick 38cm	Extg-Solid Brick 38cm	0.415	1.640	0
95ud	Extg-Half timbered 18cm	Extg-Half timbered 18cm	0.210	1.800	0
96ud	Extg-Honeycomb (perforated) brick 30cm	Extg-Honeycomb (perforated) brick 30cm	0.335	1.230	0
97ud	Extg-Precast concrete	Extg-Precast concrete	0.275	1.300	0
98ud	Extg-Wooden joist ceiling	Extg-Wooden joist ceiling	0.284	0.990	0
99ud	Extg-Basement ceiling	Extg-Basement ceiling	0.242	1.230	0

Glazing			Glazing
	Recommended glazing type to start planning: Triple thermally insulated glazing (Please consider the comfort criterion!)		
ID	Description	g-Value	U_g-Value
			W/(m²K)
01ud			
02ud			
03ud			
04ud			
05ud			
06ud			
07ud			
08ud			
09ud			
10ud			
11ud			
12ud			
13ud			
14ud			
15ud			
16ud			
17ud			
18ud			
19ud			
20ud			
21ud			
22ud			
23ud			
24ud			
25ud			
26ud			
27ud			
28ud			
29ud			
30ud			
31ud			
32ud			
33ud	**Thermadura Door Panel (From U-Values Sheet)**	**0.00**	**0.95**
34ud			
35ud	**Thermadura - ClimaGuard Premium 2 (4/18/:4 90% Ar)**	**0.64**	**1.14**
36ud	**Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)**	**0.53**	**0.52**
37ud	**Thermadura - ClimaGuard Premium2 (en=3%) (4:/20/4/20/:4 90% Ar)**	**0.53**	**0.52**
38ud	**Thermadura - Silverstar EN2plus (6:/18/6/16/:6 90% Ar)**	**0.51**	**0.55**
39ud	**Thermadura - ClimaGuard Premium2 (en=3%) (6:/18/6/16/:6 90% Ar)**	**0.52**	**0.55**
40ud	**Thermadura - Silverstar EN2plus (8:/14/8/14/:8 90% Ar)**	**0.50**	**0.64**
41ud			
42ud			
43ud			
44ud			
45ud			
46ud			
47ud			
48ud			
49ud			
50ud			
51ud			
52ud			
53ud			
54ud			
55ud			
56ud			
57ud			
58ud			
59ud			
60ud			
61ud			
62ud			
63ud			
64ud			
65ud			
66ud			

Glazing

ID	Recommended glazing type to start planning: Triple thermally insulated glazing (Please consider the comfort criterion!) Description	g-Value	U_g-Value
			W/(m²K)
67ud			
68ud			
69ud			
70ud			
71ud			
72ud			
73ud			
74ud			
75ud			
76ud			
77ud			
78ud			
79ud			
80ud			
81ud			
82ud			
83ud			
84ud			
85ud			
86ud			
87ud			
88ud			
89ud			
90ud			
91ud		0.00	0.00
92ud	Single glazing	0.87	5.80
93ud	Double glazing 4/12mm air/4	0.77	2.90
94ud	Double glazing 4/16mm air/4	0.77	2.70
95ud	Double glazing 4/20mm air/4	0.77	2.80
96ud	Double glazing 4/25mm air/4	0.77	2.80
97ud	Double glazing 4/30mm air/4	0.77	2.80
98ud	Triple glazing 4/10 air/4/10 air/4	0.70	2.00
99ud	Double low-e 4/16Argon90%/4 Epsilon=0.1	0.64	1.30

Window frames

ID	Description	U_f-Value				Frame width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
		left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge}$ 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
01ud																		
02ud	Thermadura Designline90 Larch Operable	1.160	1.160	1.210	1.160	0.128	0.128	0.128	0.128	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
03ud	Thermadura Designline90 Larch Fixed	1.160	1.160	1.210	1.160	0.091	0.091	0.091	0.091	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
04ud	Thermadura Designline90 Larch Operable with Gutman Sill	1.160	1.160	1.600	1.160	0.128	0.128	0.112	0.128	0.023	0.023	0.023	0.023	0.040	0.040	0.087	0.040	
05ud	Thermadura Designline90 Larch Operable Top Panel (W06,9,5,8,10)	1.160	1.160	1.210	1.160	0.128	0.128	0.046	0.128	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
06ud	Thermadura Designline90 Larch Fixed to Fixed Left (W03)	1.160	1.160	1.210	1.160	0.091	0.055	0.091	0.091	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
07ud	Thermadura Designline90 Larch Fixed to Fixed Right (W03)	1.160	1.160	1.210	1.160	0.055	0.091	0.091	0.091	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
08ud	Thermadura Designline90 Larch Operable French Door Middle Right (W01)	1.160	1.160	1.210	1.160	0.087	0.092	0.158	0.158	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
09ud	Thermadura Designline90 Larch Operable French Door Middle Left (W01)	1.160	1.160	1.210	1.160	0.092	0.087	0.158	0.158	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
10ud	Thermadura Designline90 Larch Operable French Door Middle (W04)	1.160	1.160	1.210	1.160	0.056	0.056	0.128	0.128	0.023	0.023	0.023	0.023	0.040	0.040	0.040	0.040	
11ud																		
12ud																		
13ud																		
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44ud																		
45ud																		
46ud																		
47ud																		
48ud																		
49ud																		
50ud																		
51ud	PH-FRAMES: average thermal quality	0.75	0.75	0.75	0.75	0.140	0.140	0.140	0.140	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.000
52ud	PH-FRAMES: good thermal quality	0.72	0.72	0.72	0.72	0.140	0.140	0.140	0.140	0.035	0.035	0.035	0.035	0.040	0.040	0.040	0.040	0.000
53ud	EXISTING: timber 45 mm	2.50	2.50	2.50	2.50	0.140	0.140	0.140	0.140	0.050	0.050	0.050	0.050	0.040	0.040	0.040	0.040	0.000
54ud	EXISTING: timber 68 mm	1.60	1.60	1.60	1.60	0.140	0.140	0.140	0.140	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.000
55ud	EXISTING: synthetic, good	1.60	1.60	1.60	1.60	0.140	0.140	0.140	0.140	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.000
56ud	EXISTING: synthetic before 1998	1.80	1.80	1.80	1.80	0.140	0.140	0.140	0.140	0.050	0.050	0.050	0.050	0.040	0.040	0.040	0.040	0.000
57ud	EXISTING: synthetic, before 1972	2.20	2.20	2.20	2.20	0.140	0.140	0.140	0.140	0.050	0.050	0.050	0.050	0.040	0.040	0.040	0.040	0.000
58ud	EXISTING: metal, thermal break	2.40	2.40	2.40	2.40	0.140	0.140	0.140	0.140	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.000
59ud	EXISTING: metal, no thermal break	4.50	4.50	4.50	4.50	0.140	0.140	0.140	0.140	0.030	0.030	0.030	0.030	0.040	0.040	0.040	0.040	0.000
60ud	EXISTING: metal, no thermal break, paint finish	5.50	5.50	5.50	5.50	0.140	0.140	0.140	0.140	0.030	0.030	0.030	0.030	0.040	0.040	0.040	0.040	0.000
61ud	INSTALLATION SITUATION: timber, not insulated, masonry, not insulated	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000
62ud	INSTALLATION SITUATION: timber, not insulated, covered with 60 mm EIFS	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
63ud	INSTALLATION SITUATION: PVC, not insulated, masonry, not insulated	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000
64ud	INSTALLATION SITUATION: PVC, not insulated,insulated with EIFS 6cm WDVS 6 cm	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
65ud	INSTALLATION SITUATION: Metal, no thermal break, masonry wall, not insulated	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.000	0.000	0.000	0.000
66ud	INSTALLATION SITUATION: insulated timber, EIFS, in insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000

Window frames

Window frames

		U_f-Value				Frame width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
ID	Description	left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge}$ 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
67ud	INSTALLATION SITUATION: insulated timber, EIFS, partially on masonry wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.000
68ud	INSTALLATION SITUATION: insulated timber, EIFS, flush with the masonry wall on the outs	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.076	0.000	0.000	0.000	0.000
69ud	INSTALLATION SITUATION: insulated timber, lightweight wall (optimal)	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000
70ud	INSTALLATION SITUATION: insulated timber, insulated concrete formwork (optimal)	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
71ud	INSTALLATION SITUATION: insulated PVC, EIFS, insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000
72ud	INSTALLATION SITUATION: insulated PVC, EIFS, partially on masonry wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.000
73ud	INSTALLATION SITUATION: insulated PVC, EIFS, flush with the masonry wall on the outsid	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.076	0.000	0.000	0.000	0.000
74ud	INSTALLATION SITUATION: insulated PVC, lightweight wall (optimal)	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000
75ud	INSTALLATION SITUATION: insulated PVC, insulated concrete formwork (optimal)	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
76ud	INSTALLATION SITUATION: insulated timber-aluminium, EIFS, insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000
77ud	INSTALLATION SITUATION: insulated timber-aluminium, EIFS, partially on masonry wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.000
78ud	INSTALLATION SITUATION: insulated timber-aluminium, lightweight wall (centre)	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000
79ud	INSTALLATION SITUATION: insulated timber-aluminium, insulated concrete formwork (opti	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
80ud	INSTALLATION SITUATION: insulated timber-aluminium, insulated concrete formwork (insi	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000
81ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum casing, EIFS, insulatio	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
82ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum casing, lightweight wa	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000
83ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum casing, insulated conc	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000
84ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum casing, insulated conc	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000
85ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, outside, in front of the facade	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.343	0.000	0.000	0.000	0.000
86ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, flush with the facade on the outsi	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.000	0.000	0.000	0.000
87ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, in the insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.000	0.000	0.000	0.000
88ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, between insulation layer and wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.059	0.000	0.000	0.000	0.000
89ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, flush with the insulation layer on t	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.397	0.000	0.000	0.000	0.000
90ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, outside, in front of the facade	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.666	0.000	0.000	0.000	0.000
91ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, flush with the insulation layer on th	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.000	0.000	0.000	0.000
92ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, in the insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.000	0.000	0.000	0.000
93ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, between insulation layer and wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.062	0.000	0.000	0.000	0.000
94ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, flush with the insulation layer on th	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.409	0.000	0.000	0.000	0.000
95ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, outside, in front of the facade	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.747	0.000	0.000	0.000	0.000
96ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, flush with the insulation layer on th	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.000	0.000	0.000	0.000
97ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, in the insulation layer	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.000	0.000
98ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, between insulation layer and wall	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.070	0.000	0.000	0.000	0.000
99ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, flush with the insulation layer on th	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.421	0.000	0.000	0.000	0.000

Ventilation units with heat recovery

Ventilation units with heat recovery

	Recommended specifications to start planning: Frost protection: Yes; Humidity recovery: Yes	75 %		0.45	Additional Device Data								
ID	Description	Effective heat recovery efficiency	Humidity recovery efficiency	Electric efficiency	Application range		External pressure per section	Fittings Dp_{intern}	Frost protection necessary	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
01ud	Zehnder - ComfoAir350, ComfoD350, WHR930	84%	0%	0.29	71	293	100	incl.	yes	/	64	50	
02ud	Zehnder ComfoAir Q350	90%	0%	0.24	70	270	100	incl.	yes	/	52	39	
03ud	Stiebel Eltron - LWZ 170 E plus	84%	0%	0.26	59	235	100	incl.	yes	/	67	59	-
04ud													
05ud													
06ud													
07ud													
08ud													
09ud													
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11ud													
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Ventilation units with heat recovery

Ventilation units with heat recovery

	Recommended specifications to start planning: Frost protection: Yes; Humidity recovery: Yes	75 %		0.45	Additional Device Data								
ID	Description	Effective heat recovery efficiency	Humidity recovery efficiency	Electric efficiency	Application range		External pressure per section	Fittings Dp_{intern}	Frost protection necessary	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
67ud													
68ud													
69ud													
70ud													
71ud													
72ud													
73ud													
74ud													
75ud													
76ud													
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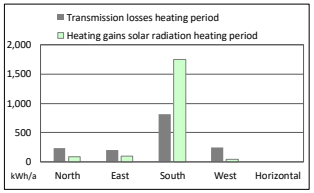
93ud													
94ud													
95ud													
96ud													
97ud	**Default HRV unit**	**75%**		**0.45**									
98ud	**Extract air unit**	**0%**		**0.25**									
99ud	Compact unit selected in 'Compact' worksheet												

Windows

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Window area orientation	Global radiation (main orientations)	Shading	Dirt	Non-vertical radiation incidence	Glazing fraction	g-Value	Solar irradiation reduction factor	Window area	Window U-Value	Glazing area	Average global radiation		Transmission losses heating period	Heating gains solar radiation heating period
Standard values →	kWh/(m²a)	0.75	0.95	0.85				m²	W/(m²K)	m²	kWh/(m²a)		kWh/a	kWh/a
North	116	0.74	0.95	0.85	0.56	0.53	0.33	4.13	1.06	2.30	124	North	240	90
East	252	0.62	0.95	0.85	0.58	0.53	0.29	3.49	1.04	2.03	186	East	200	101
South	509	0.68	0.95	0.85	0.70	0.53	0.39	17.34	0.86	12.19	493	South	819	1754
West	259	0.30	0.95	0.85	0.65	0.27	0.16	4.14	1.11	2.68	289	West	252	50
Horizontal	433	1.00	0.95	0.85	0.00	0.00	0.00	0.00	0.00	0.00	433	Horizontal	0	0
Total or average value for all windows.						0.49	0.34	29.10	0.94	19.20			1511	1995



Heating degree hours [kKh/a]: 55.0

Recommendation for $U_{w,installed}$ [W/(m²K)

1.05	1.10	1.20	0.70

Go to glazing list Go to window frames list

Qua n-tity	Description	Deviation from north	Angle of inclination from the horizontal	Orien- tation	Window rough openings Width	Window rough openings Height	Installed in: Selection from 'Areas' worksheet	Glazing: Selection from 'Components' worksheet	Frame: Selection from 'Components' worksheet	g-Value: Perpen-dicular radiation	U-Value: Glazing	U-Value: Frames (avg.)	Ψ Glazing edge: $\Psi_{Glazing\ edge}$ (Avg.)	Installation situation: left	right	bottom	top	$\Psi_{Installation}$ (Avg.)	Results: Window Area	Glazing area	U_w installed	Glazed fraction per window
		°	°		m	m		1-Sorting: LIKE LIST	1-Sorting: LIKE LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%
1	W13	-83.6	90	West	0.940	2.200	6-WL06	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	04ud-Thermadura Designline90 Larch Operabel with Gutman Sill	0.53	0.52	1.22	0.023	1	1	1	1	0.047	2.1	1.34	0.97	65%
1	W02	-112.1	90	West	0.940	2.200	7-WL02	33ud-Thermadura Door Panel (From U-Values Sheet)	04ud-Thermadura Designline90 Larch Operabel with Gutman Sill	0.00	0.95	1.22	0.023	1	1	1	1	0.047	2.1	1.34	1.24	65%
1	W03a	157.9	90	South	0.790	2.200	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	06ud-Thermadura Natureline90 Larch Fixed to Fixed Left (W03)	0.53	0.52	1.17	0.023	1	0	1	1	0.040	1.7	1.30	0.84	75%
1	W03b	157.9	90	South	0.790	2.200	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	07ud-Thermadura Natureline90 Larch Fixed to Fixed Right (W03)	0.53	0.52	1.17	0.023	0	1	1	1	0.040	1.7	1.30	0.84	75%
1	W01a	-173.6	90	South	0.750	2.200	9-WL01	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	0	1	1	1	0.040	1.7	1.15	0.88	69%
1	W01b	-173.6	90	South	0.840	2.200	9-WL01	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	09ud-Thermadura Natureline90 Larch Operable French Door Middle Left (W01)	0.53	0.52	1.17	0.023	0	0	1	1	0.040	1.8	1.25	0.83	67%
1	W01c	-173.6	90	South	0.840	2.200	9-WL01	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	08ud-Thermadura Natureline90 Larch Operable French Door Middle Right (W01)	0.53	0.52	1.17	0.023	0	0	1	1	0.040	1.8	1.25	0.83	67%
1	W01d	-173.6	90	South	0.750	2.200	9-WL01	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	0	1	1	0.040	1.7	1.15	0.88	69%
1	W04c	157.9	90	South	0.790	2.200	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	0	1	1	1	0.040	1.7	1.23	0.87	71%
1	W04b	157.9	90	South	0.850	2.200	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	10ud-Thermadura Natureline90 Larch Operable French Door Middle (W04)	0.53	0.52	1.17	0.023	0	0	1	1	0.040	1.9	1.43	0.78	77%
1	W04a	157.9	90	South	0.790	2.200	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	0	1	1	0.040	1.7	1.23	0.87	71%
1	W05b	157.9	90	South	0.780	1.280	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	1	1	0	0.040	1.0	0.66	0.96	66%
1	W06b	67.9	90	East	0.780	1.280	4-WL04	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	1	1	0	0.040	1.0	0.66	0.96	66%
1	W08b	67.9	90	East	0.780	1.280	4-WL04	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	1	1	0	0.040	1.0	0.66	0.96	66%
1	W09b	-22.1	90	North	0.780	1.280	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	1	1	0	0.040	1.0	0.66	0.96	66%
1	W10b	-22.1	90	North	0.780	1.280	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.17	0.023	1	1	1	0	0.040	1.0	0.66	0.96	66%
1	W05a	157.9	90	South	0.780	0.670	3-WL03	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	05ud-Thermadura Natureline90 Larch Operable Top Panel (W06,9,5,8,10)	0.53	0.52	1.17	0.023	1	1	0	1	0.040	0.5	0.26	1.10	50%
1	W06a	67.9	90	East	0.780	0.670	4-WL04	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	05ud-Thermadura Natureline90 Larch Operable Top Panel (W06,9,5,8,10)	0.53	0.52	1.17	0.023	1	1	0	1	0.040	0.5	0.26	1.10	50%
1	W08a	67.9	90	East	0.780	0.670	4-WL04	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	05ud-Thermadura Natureline90 Larch Operable Top Panel (W06,9,5,8,10)	0.53	0.52	1.17	0.023	1	1	0	1	0.040	0.5	0.26	1.10	50%
1	W09a	-22.1	90	North	0.780	0.670	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	05ud-Thermadura Natureline90 Larch Operable Top Panel (W06,9,5,8,10)	0.53	0.52	1.17	0.023	1	1	0	1	0.040	0.5	0.26	1.10	50%
1	W10a	-22.1	90	North	0.780	0.670	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	05ud-Thermadura Natureline90 Larch Operable Top Panel (W06,9,5,8,10)	0.53	0.52	1.17	0.023	1	1	0	1	0.040	0.5	0.26	1.10	50%
1	W11	-22.1	90	North	0.780	0.700	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	02ud-Thermadura Natureline90 Larch Operable	0.53	0.52	1.18	0.023	1	1	1	1	0.040	0.5	0.23	1.20	43%
1	W12	-22.1	90	North	0.780	0.700	5-WL05	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	02ud-Thermadura Natureline90 Larch Operable	0.53	0.52	1.18	0.023	1	1	1	1	0.040	0.5	0.23	1.20	43%
1	W07	67.9	90	East	1.170	0.380	4-WL04	36ud-Thermadura - Silverstar EN2plus (4:/20/4/20/:4 90% Ar)	03ud-Thermadura Natureline90 Larch Fixed	0.53	0.52	1.18	0.023	1	1	1	1	0.040	0.4	0.20	1.29	44%
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Heating degree hours [kKh/a]: **55.0**

					Window rough openings		Installed in	Glazing	Frame	g-Value	U-Value		Ψ Glazing edge	Installation situation user determined value for $\Psi_{installation}$ or '1': $\Psi_{installation}$ from 'Components' worksheet '0': in the case of abutting windows					Results			
Quan-tity	Description	Deviation from north	Angle of inclination from the horizontal	Orien- tation	Width	Height	Selection from 'Areas' worksheet	Selection from 'Components' worksheet	Selection from 'Components' worksheet	Perpen-dicular radiation	Glazing	Frames (avg.)	$\Psi_{Glazing\ edge}$ (Avg.)	left	right	bottom	top	$\Psi_{Installation}$ (Avg.)	Window Area	Glazing area	U_w installed	Glazed fraction per window
		°	°		m	m		1-Sorting: LIKE LIST	1-Sorting: LIKE LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%
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	-																					
	-																					
	-																					
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	-																					

Calculation of shading coefficients

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Latitude: 43.5 °

Orientation	Glazing area [m²]	Reduction factor winter r_{s_w}	Reduction factor cooling r_{s_c1}	Reduction factor cooling load r_{s_c2}	Solar load [kWh/(m²$_{Glazing}$a)]
North	2.30	74%	73%	73%	129
East	2.03	62%	65%	65%	176
South	12.19	68%	59%	59%	285
West	2.68	30%	33%	33%	121
Horizontal	0.00	100%	100%	100%	0

								Horizon		Lateral reveal		Reveal / Overhang						Reduction factors for shading in winter				Reduction factors for shading in summer				
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 reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Regulated / transparent	Horizon	Reveal	Overhang	Total for heating case	Horizon	Reveal	Overhang	Total for cooling case	Total for cooling load
		[Degree]	[Degree]		w_G [m]	h_G [m]	A_G [m²]	h_{Hor} [m]	d_{Hor} [m]	o_{Reveal} [m]	d_{Reveal} [m]	o_{over} [m]	d_{over} [m]	$r_{other,w}$ [%]	$r_{other,s}$ [%]	z [%]		r_H [%]	r_R [%]	r_O [%]	r_S [%]	r_H [%]	r_R [%]	r_O [%]	$r_{S,1}$ [%]	$r_{S,2}$ [%]
1	W13	-84	90	West	0.68	1.96	1.3							30%	33%						30%				33%	33%
1	W02	-112	90	West	0.68	1.96	1.3							0%	0%						0%				0%	0%
1	W03a	158	90	South	0.64	2.02	1.3							86%	75%						86%				75%	75%
1	W03b	158	90	South	0.64	2.02	1.3							85%	76%						85%				76%	76%
1	W01a	-174	90	South	0.57	2.02	1.1							45%	36%						45%				36%	36%
1	W01b	-174	90	South	0.66	1.88	1.2							38%	34%						38%				34%	34%
1	W01c	-174	90	South	0.66	1.88	1.2							41%	34%						41%				34%	34%
1	W01d	-174	90	South	0.57	2.02	1.1							46%	35%						46%				35%	35%
1	W04c	158	90	South	0.61	2.02	1.2							86%	74%						86%				74%	74%
1	W04b	158	90	South	0.74	1.94	1.4							86%	75%						86%				75%	75%
1	W04a	158	90	South	0.61	2.02	1.2							86%	73%						86%				73%	73%
1	W05b	158	90	South	0.60	1.10	0.7							85%	76%						85%				76%	76%
1	W06b	68	90	East	0.60	1.10	0.7							59%	63%						59%				63%	63%
1	W08b	68	90	East	0.60	1.10	0.7							59%	61%						59%				61%	61%
1	W09b	-22	90	North	0.60	1.10	0.7							69%	65%						69%				65%	65%
1	W10b	-22	90	North	0.60	1.10	0.7							69%	65%						69%				65%	65%
1	W05a	158	90	South	0.52	0.50	0.3							81%	53%						81%				53%	53%
1	W06a	68	90	East	0.52	0.50	0.3							70%	72%						70%				72%	72%
1	W08a	68	90	East	0.52	0.50	0.3							70%	72%						70%				72%	72%
1	W09a	-22	90	North	0.52	0.50	0.3							80%	82%						80%				82%	82%
1	W10a	-22	90	North	0.52	0.50	0.3							81%	83%						81%				83%	83%
1	W11	-22	90	North	0.52	0.44	0.2							82%	84%						82%				84%	84%
1	W12	-22	90	North	0.52	0.44	0.2							81%	84%						81%				84%	84%
1	W07	68	90	East	0.99	0.20	0.2							66%	66%						66%				66%	66%

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 reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Regulated / transparent	Horizon	Reveal	Overhang	**Total for heating case**	Horizon	Reveal	Overhang	**Total for cooling case**	**Total for cooling load**
		[Degree]	[Degree]		w_G [m]	h_G [m]	A_G [m^2]	h_{Hori} [m]	d_{Hori} [m]	o_{Reveal} [m]	d_{Reveal} [m]	o_{over} [m]	d_{over} [m]	$r_{other,w}$ [%]	$r_{other,s}$ [%]	z [%]		r_H [%]	r_R [%]	r_O [%]	r_S [%]	r_H [%]	r_R [%]	r_O [%]	$r_{S,1}$ [%]	$r_{S,2}$ [%]
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Ventilation data

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Treated floor area A_{TFA}	m²	122		*('Areas' worksheet)*
Room height h	m	2.50	2.50	
Volume of ventilated space (A_{TFA}*h) V_V	m³	304		*(Worksheet 'Annual heating')*

Ventilation type

Please select: **1-Balanced PH ventilation with HR**

Infiltration air change rate

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

			For annual demand:	For heating load:	Net air volume for press. test V_{n50}		Air permeability q_{50}	
Wind protection coefficient, e			0.07	0.18				
Wind protection coefficient, f			15	15				
Air change rate at press. test	n_{50}	1/h	0.37	0.37	296	m³	0.24	m³/(hm²)

			For annual demand:	For heating load:
Excess extract air		1/h	0.00	0.00
Infiltration air change rate	$n_{V,Rest}$	1/h	0.025	0.063

Selection of ventilation input - Results

PHPP offers two methods for dimensioning air quantities and choosing the ventilation unit. With "Standard data input for balanced ventilation", supply or extract air quantities for residential buildings and parameters for ventilation systems with a maximum of 1 ventilation unit can be planned. Projects with up to 10 different ventilation units and air quantities determined according to rooms or zones can be entered in the 'Addl vent' worksheet. Please select your design method here:

	Ventilation unit / Heat recovery efficiency design		Average air flow rate m³/h	Average air change rate 1/h	Extract air excess (extract air system) 1/h	Effective heat recovery efficiency unit [-]	Humidity recovery efficiency [-]	Specific power input Wh/m³	Heat recovery efficiency SHX [-]
x	Standard design	*('Ventilation' worksheet, see below)*	92	0.30	0.00	87.9%	0.0%	0.24	0.0%
	Multiple ventilation units, non-res	*('Addl vent' worksheet)*							

Cooling recovery	Efficiency SHX η^*_{SHX}
	0%

Average interior humidity during winter operation

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
47%	49%	51%	55%	58%	66%	67%	72%	68%	62%	54%	47%

Standard data input for balanced ventilation

Dimensioning of ventilation system with only one ventilation unit

Occupancy	m²/P	45				
Number of occupants	P	2.7				
Supply air per person	m³/(P*h)	30				
Supply air requirement	m³/h	80		Bathroom		
Extract air rooms		Kitchen	Bathroom	(shower only)	WC	Laundry
Quantity		1		2		1
Extract air requirement per room	m³/h	60	40	20	20	20
Total extract air requirement	m³/h	120				

Design air flow rate (maximum) m³/h **120** Recommended: 120 m³/h

Average air change rate calculation

Type of operation	Daily operation times h/d	Factors referenced to maximum	Air flow rate m³/h	Air change rate 1/h
maximum		1.00	120	0.39
Standard	**24.0**	**0.77**	92	0.30
Basic ventilation		**0.54**	65	0.21
Minimum		**0.40**	48	0.16
	Average value	0.77	Average air flow rate (m³/h) **92**	Average air change rate (1/h) **0.30**

Selection of ventilation unit with heat recovery

Location of ventilation unit: **1-Inside thermal envelope**

	Go to ventilation units list 1-Sorting: LIKE LIST	Heat recovery efficiency	Humidity recovery efficiency	Specific efficiency [Wh/m³]	Application [m³/h]	Frost power input
Ventilation unit selection	**02ud-Zehnder ComfoAir Q350**	0.90	0.00	0.24	70 - 270	yes

Conductivity outdoor air duct	Ψ	W/(mK)	0.776	Implementation of frost protection	1-No
Length of outdoor air duct		m	0.5	Limit temperature [°C]	
Conductivity exhaust air duct	Ψ	W/(mK)	0.776	Useful energy [kWh/a]	0
Length of exhaust air duct		m	0.5		
Temperature of mechanical services room		°C		Room temperature (°C)	20
(Enter only if the central unit is outside of the thermal envelope)				Avg. ambient temp. heat. period (°C	8.9
				Avg. ground temp (°C)	12.6

Effective heat recovery efficiency $\eta_{HR,eff}$ **87.9%**

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	
Heat recovery efficiency SHX	η_{SHX}	0%

Secondary calculation
Ψ-value supply or outdoor air duct

Nominal width	150	mm
Insulation thic	15	mm
Reflective coating?		Yes
	x	No
Thermal conductivity	0.040	W/(mK)
Nominal air flow rate	92	m³/h
Δϑ	11	K
Exterior duct diameter	0.150	m
Exterior diameter	0.180	m
α–Interior	7.58	W/(m²K)
α-Surface	6.26	W/(m²K)
Ψ–value	**0.776**	**W/(mK)**
Surface temperature difference	2.430	K

Secondary calculation
Ψ-value extract or exhaust air duct

Nominal width:	150	mm
Insulation thickness	15	mm
Reflective coating?		yes
	x	no
Thermal conductivity	0.040	W/(mK)
Nominal air flow rate	92	m³/h
Δϑ	11	K
Exterior duct diameter	0.150	m
Exterior diameter	0.180	m
α–Interior	7.58	W/(m²K)
α-Surface	6.26	W/(m²K)
Ψ–value	**0.776**	**W/(mK)**
Surface temperature difference	2.430	K

Specific energy for heating (monthly method)

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

The sum of the heating periods calculated through the monthly method will be presented on this side.

Interior temperature:	20	°C
Building type:	Single Family Detached	
Treated floor area A_{TFA}:	121.8	m²
Spec. Capacity:	60	Wh/(m²K)

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Month. red. fac.		G_t kKh/a		kWh/a	Per m² of treated floor area
External wall - Ambient	A	131.8	*	0.224	*	1.00	*	79	=	2326	19.11
External wall - Ground	B		*		*	1.00	*		=		
Roof/Ceiling - Ambient	A	138.6	*	0.097	*	1.00	*	79	=	1060	8.70
Floor slab / Basement ceiling	B	138.6	*	0.218	*	1.00	*	49	=	1480	12.15
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
Garage Walls	X	23.5	*	0.292	*	0.97	*	79	=	524	4.30
Windows	A	29.1	*	0.945	*	1.00	*	79	=	2167	17.80
Exterior door	A		*		*	1.00	*		=		
Exterior TB (length/m)	A		*		*	1.00	*		=		0.00
Perimeter TB (length/m)	P	78.8	*	-0.104	*	1.00	*	49	=	-401	-3.29
Ground TB (length/m)	B	18.8	*	0.067	*	1.00	*	49	=	61	0.50
											kWh/(m²a)
Transmission heat losses Q_T									Total	7217	59.3

	A_{TFA} m²		Clear room height m		m³
Effective air volume V_V	122	*	2.50	=	304

	$n_{V,system}$ 1/h		η*SHX		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective air change rate Ambient nV,e	0.303	*(1-	0%	)*(1-	0.88	)+	0.025	=	0.062
Effective air change rate Ground nV,g	0.303	*	0%	*(1-	0.88	)		=	0.000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	304	*	0.062	*	0.33	*	79	=	491	4.0
Ventilation losses ground $Q_{V,e}$	304	*	0.000	*	0.33	*	65	=	0	0.0
Ventilation heat losses Q_V								Total	491	4.0

	Q_T kWh/a		Q_V kWh/a		Reduction factor night/weekend saving		kWh/a	kWh/(m²a)
Total heat losses Q_L	(7217	+	491	) *	1.0	=	7708	**63.3**

Orientation of the area	Reduction factor see 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a
North	0.33	*	0.53	*	4.1	*	390	=	284
East	0.29	*	0.53	*	3.5	*	600	=	325
South	0.39	*	0.53	*	17.3	*	1072	=	3812
West	0.16	*	0.27	*	4.1	*	808	=	139
Horizontal	0.00	*	0.00	*	0.0	*	1353	=	0
Sum opaque areas									954
									kWh/(m²a)
Available solar heat gains Q_S								Total	5514	45.3

	kh/d		Length Heat. Period d/a		Spec. Power q_I W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
Internal heat gains Q_I	0.024	*	365	*	2.5	*	121.8	=	2678	22.0

			kWh/a	kWh/(m²a)
Free heat Q_F	Q_S + Q_I	=	8192	67.3
Ratio free heat to losses	Q_F / Q_L	=	1.06	
Utilisation factor heat gains h_G		=	71%	
			kWh/a	kWh/(m²a)
Heat gains Q_G	η_G * Q_F	=	5789	**47.5**

			kWh/a	kWh/(m²a)
Annual heating demand Q_H	Q_L - Q_G	=	1919	**16**

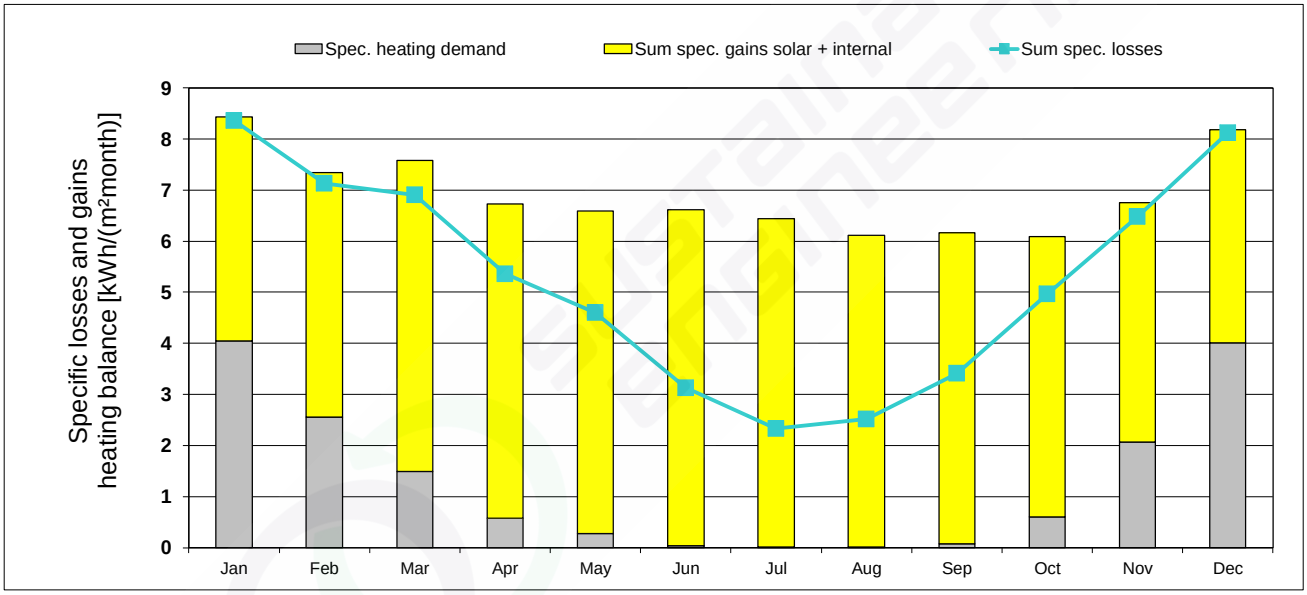
	kWh/(m²*a)		(Yes/No)
Limiting value	15	**Requirement met?**	**No**

Specific energy for heating (monthly method)

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Interior temperature: 20 °C
Building type: Single Family Detached
Treated floor area A_{TFA}: 122 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - External	10.7	9.0	8.5	6.4	5.4	3.7	2.7	3.1	4.2	6.3	8.4	10.5	79	kKh
Heating degree hours - Ground	5.4	5.2	5.8	5.2	4.7	3.1	2.5	2.2	2.9	3.3	3.9	4.8	49	kKh
Losses - Exterior	891	746	706	531	450	309	225	257	349	527	699	878	6568	kWh
Losses - Ground	126	122	134	121	110	71	59	50	66	78	90	111	1140	kWh
Sum spec. losses	8.4	7.1	6.9	5.4	4.6	3.1	2.3	2.5	3.4	5.0	6.5	8.1	63.3	kWh/m²
Solar gains - North	10	14	21	29	36	43	40	30	24	17	11	8	284	kWh
Solar gains - East	9	15	26	35	42	51	45	33	30	19	12	7	325	kWh
Solar gains - South	245	289	375	353	333	341	334	337	368	331	278	227	3812	kWh
Solar gains - West	6	7	12	14	16	17	17	15	13	10	6	5	139	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	36	51	80	98	115	129	121	100	87	63	42	32	954	kWh
Internal heat gains	227	205	227	220	227	220	227	227	220	227	220	227	2678	kWh
Sum spec. gains solar + internal	4.4	4.8	6.1	6.2	6.3	6.6	6.4	6.1	6.1	5.5	4.7	4.2	67.3	kWh/m²
Utilisation factor	98%	96%	89%	78%	68%	47%	36%	41%	55%	80%	94%	99%	71%	
Annual heating demand	492	312	182	70	33	4	1	2	9	73	252	488	1919	kWh
Spec. heating demand	**4.0**	**2.6**	**1.5**	**0.6**	**0.3**	**0.0**	**0.0**	**0.0**	**0.1**	**0.6**	**2.1**	**4.0**	**15.8**	kWh/m²



Annual heating demand: Comparison

Monthly method	*('Heating')*	1919	kWh/a	15.8	**kWh/(m²a)** reference to treated floor area according to PHPP
Annual method	*('Annual heati*	2047	kWh/a	16.8	**kWh/(m²a)** reference to treated floor area according to PHPP
		#REF!	kWh/a	#REF!	

Heating load

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Interior temperature: 20 °C
Building type: Single Family Detached
Treated floor area A_{TFA}: 121.8 m²

	Design temperature		Radiation:	North	East	South	West	Horizontal	
Weather 1:	1.9	°C		10	35	110	35	45	W/m²
Weather 2:	4.6	°C		10	10	20	15	20	W/m²
Ground design temp.	12.2	°C							

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Factor always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		PT 1 W		PT 2 W
External wall - Ambient	A	131.8	*	0.224	*	1.00	*	18.1	or	15.4	=	534	or	454
External wall - Ground	B		*		*	1.00	*	7.8	or	7.8	=		or	
Roof/Ceiling - Ambient	A	138.6	*	0.097	*	1.00	*	18.1	or	15.4	=	243	or	207
Floor slab / Basement ceiling	B	138.6	*	0.218	*	1.00	*	7.8	or	7.8	=	235	or	235
	A		*		*	1.00	*	18.1	or	15.4	=		or	
	A		*		*	1.00	*	18.1	or	15.4	=		or	
Garage Walls	X	23.5	*	0.292	*	0.97	*	18.1	or	15.4	=	120	or	102
Windows	A	29.1	*	0.945	*	1.00	*	18.1	or	15.4	=	497	or	423
Exterior door	A		*		*	1.00	*	18.1	or	15.4	=		or	
Exterior TB (length/m)	A		*		*	1.00	*	18.1	or	15.4	=		or	
Perimeter TB (length/m)	P	78.8	*	-0.104	*	1.00	*	7.8	or	7.8	=	-64	or	-64
Ground TB (length/m)	B	18.8	*	0.067	*	1.00	*	7.8	or	7.8	=	10	or	10
Building element towards neighbour	I		*		*	1.00	*	3.0	or	3.0	=		or	

Transmission heat load P_T

Total = 1576 or 1368

Ventilation system:

Effective air volume, V_V: A_{TFA} 121.8 m² * Clear room height 2.50 m = 304 m³

Heat recovery efficiency of the heat exchanger η_{HR} 88%
Heat recovery efficiency SHX 0%
Heat recovery efficiency SHX $\eta_{SHX\ 1}$ 0% or $\eta_{SHX\ 2}$ 0%

Energetically effective air changes n_V: $n_{V,Res}$ (Heating Load) 0.063 1/h + $n_{V,system}$ 0.303 1/h *(1- Φ_{HP} 0.88 or Φ_{HP} 0.88) = 0.100 1/h or 0.100 1/h

Ventilation heat load P_V

V_V m³		n_V 1/h		n_V 1/h		c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
304.4	*	0.100	or	0.100	*	0.33	*	18.1	or	15.4	=	181	or	154

Total heating load P_L

$P_T + P_V$ = PL 1: 1757 W or PL 2: 1522 W

Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
North	4.1	*	0.5	*	0.33	*	10	or	11	=	7	or	8
East	3.5	*	0.5	*	0.29	*	20	or	9	=	11	or	5
South	17.3	*	0.5	*	0.39	*	105	or	19	=	375	or	68
West	4.1	*	0.3	*	0.16	*	44	or	16	=	7	or	3
Horizontal	0.0	*	0.0	*	0.40	*	45	or	20	=	0	or	0

Solar heating power P_S

Total = 400 or 83

Internal heating load P_I

Spec. power 2.0 W/m² * A_{TFA} 122 m² = P_I 1: 245 W or P_I 2: 245 W

Heating power (gains) P_G

$P_T + P_I$ = P_G 1: 645 W or P_G 2: 328 W

$P_L - P_G$ = 1112 or 1194

Heating load P_H = 1194 W

Area specific space heating load P_H / A_{TFA} = 9.8 W/m²

Input max. supply air temperature 52 °C
Max. supply air temperature $\vartheta_{Supply,Max}$ 52 °C

Supply air temperature without heating $\vartheta_{Supply,Min}$: 17.8 °C or 18.1 °C

For comparison: heating load transportable by the supply Air $P_{Supply\ Air,Max}$ = 1032 W specific: 8.5 W/m²

Supply air heating: Sufficient? (Yes/No) No

Summer ventilation

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Building volume:	304	m³	Building type:	Single Family Detached	
Max. indoor absolute humidity:	12	g/kg	Heat recovery efficiency:	88%	
Internal humidity sources:	100	g/(P*h)	Humidity recovery efficiency:	0%	
			Subsoil heat exchanger efficiency:	0%	

Results passive cooling			Results active cooling		
Frequency of overheating:	5.7%	at the overheating limit ϑ_{max} = 25 °C	Useful cooling demand:	3.2	kWh/(m²a)
max. humidity:	12.1	g/kg	Dehumidification demand:	0.0	kWh/(m²a)
Frequency of exceeded humidity:	0.2%		Frequency of exceeded humidity:	0.2%	

Summer basic ventilation to ensure adequate air quality

Air change rate via vent. system with supply a: 0.30 1/h

HRV/ERV in summer (check only one field)

None	
Automatic bypass, controlled by temperature difference	x
Automatic bypass, controlled by enthalpy difference	
Always	

Air change rate via extract air system: 0.00 1/h

Specific power consumption (for extract air system): 0.00 Wh/m³

Window ventilation air change rate: 0.03 1/h

Effective air change rate

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HP}		$n_{V,equi,fraction}$ 1/h	
Exterior $n_{V,e}$	0.300	*(1-	0%	)*(1-	0.88	) =	0.036	
without HR	0.300	*(1-	0%	)		=	0.300	
Ground $n_{L,g}$	0.300	*	0%	*(1-	0.88	) =	0.000	
without HR	0.300	*	0%			=	0.000	

Ventilation conductance

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)			
exterior $H_{V,e}$	304	*	0.036	*	0.33	=	3.7	W/K
without HR	304	*	0.300	*	0.33	=	30.1	W/K
ground $H_{V,g}$	304	*	0.000	*	0.33	=	0.0	W/K
without HR	304	*	0.000	*	0.33	=	0.0	W/K
Infiltration, window, extract air system	304	*	0.058	*	0.33	=	5.8	W/K

Additional summer ventilation for cooling

Additional ventilation regulation

Minimum acceptable indoor temp. 22.0 °C

Type of additional ventilation

Window night ventilation, manual — Night ventilation value 0.04 1/h

Mechanical, automatically Controlled ventilation

Corresponding air change rate 0.00 1/h
during operation, in addition to basic air change
Specific power consumption 0.00 Wh/m³

Controlled by (please check)
Temperature diff.
Humidity diff. x

Secondary calculation: Hygienic air change rate through window ventilation

Estimation for window air change rate to ensure sufficient air quality

Description		W09,W10						
	Open duration [h/d]	9						
Climate boundary conditions								
	Temperature diff interior - exterior	4						K
	Wind velocity	1						m/s
Window group 1								
	Quantity	2						
	Clear width	0.52						m
	Clear height	0.48						m
	Tilting window (check if appropriate)	x						
	Opening width (for tilting windows)	0.100						m
Window group 2 (cross ventilation)								
	Quantity							
	Clear width							m
	Clear height							m
	Tilting window (check if appropriate)							
	Opening width (for tilting windows)							m
	Difference in height to window 1							m
							Total	
Result: Air change rate		0.03	0.00	0.00	0.00	0.00	0.00	0.03 1/h

Secondary calculation: Additional night ventilation for cooling

Air change value during additional window night ventilation

Description		W05,W06						
	Reduction factor							
Climate boundary conditions								
	Temperature diff interior - exterior	1	1	1	1	1	1	K
	Wind velocity	0	0	0	0	0	0	m/s
Window group 1								
	Quantity	2						
	Clear width	0.52						m
	Clear height	0.48						m
	Tilting window (check if appropriate)	x						
	Opening width (for tilting windows)	0.100						m
Window group 2 (cross ventilation)								
	Quantity							
	Clear width							m
	Clear height							m
	Tilting window (check if appropriate)							
	Opening width (for tilting windows)							m
	Difference in height to window 1							m
							Total	
Result: Night ventilation values		0.04	0.00	0.00	0.00	0.00	0.00	0.04 1/h

Summer: Passive cooling

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Building type:	Single Family Detached		Treated floor area A_{TFA}:	121.8	m²
Upper temperature limit:	25	°C	Building volume:	304	m³
Nominal humidity:	12	g/kg	Internal humidity sources:	2.2	g/(m²h)
Spec. capacity:	60	Wh/(m²K)			

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Red. factor $f_{T,Summer}$		H_{Summer} heat conductance
External wall - Ambient	A	131.8	*	0.224	*	1.00	=	29.5
External wall - Ground	B		*		*	1.00	=	
Roof/Ceiling - Ambient	A	138.6	*	0.097	*	1.00	=	13.4
Floor slab / Basement ceiling	B	138.6	*	0.218	*	1.00	=	30.3
	A		*		*	1.00	=	
	A		*		*	1.00	=	
Garage Walls	X	23.5	*	0.292	*	0.97	=	6.6
Windows	A	29.1	*	0.945	*	1.00	=	27.5
Exterior door	A		*		*	1.00	=	
Exterior TB (length/m)	A		*		*	1.00	=	
Perimeter TB (length/m)	P	78.8	*	-0.104	*	1.00	=	-8.2
Ground TB (length/m)	B	18.8	*	0.067	*	1.00	=	1.3

Exterior thermal transmittance, $H_{T,e}$	77.1	W/K
Ground thermal transmittance, $H_{T,g}$	23.3	W/K

Summer ventilation

from 'SummVent' worksheet

Ventilation unit conductance			Ventilation parameter			Summer ventilation regulation	
							HRV/ERV
exterior $H_{V,e}$	3.7	W/K	Temperature amplitude summer	9.3	K		
without HR	30.1	W/K	Minimum acceptable indoor temperature	22.0	°C	None	
ground $H_{V,g}$	0.0	W/K	Heat capacity air	0.33	Wh/(m³K)	Controlled by temperature	x
without HR	0.0	W/K	Supply air changes	0.30	1/h	Controlled by enthalpy	
Ventilation conductance, others			Outdoor air changes	0.06	1/h	Always	
exterior	5.8	W/K	Window night ventilation air change rate, manual @ 1K	0.04	1/h		Additional ventilation
			Air change rate due to mech. automatically controlled vent.	0.00	1/h	Controlled by temperature	
			Specific power consumption for	0.00	Wh/m³	Controlled by humidity	x
			η_{HR}	88%			
			η_{ERV}	0%			
			η^*_{SHX}	0%			

Orientation of the area	Angle factor Summer		Shading factor Summer		Shading dirt		g-Value (perp. radiation)		Area m²		Portion of glazing		Aperture m²
North	0.9	*	0.73	*	0.95	*	0.53	*	4.1	*	56%	=	0.8
East	0.9	*	0.65	*	0.95	*	0.53	*	3.5	*	58%	=	0.6
South	0.9	*	0.59	*	0.95	*	0.53	*	17.3	*	70%	=	3.2
West	0.9	*	0.33	*	0.95	*	0.27	*	4.1	*	65%	=	0.2
Horizontal	0.9	*	1.00	*	0.95	*	0.00	*	0.0	*	0%	=	0.0
Sum opaque areas													1.0

Solar aperture	Total	5.8	m²/m² 0.05

	Specif. power q_I W/m²		A_{TFA} m²		W	W/m²
Internal heat gains Q_I	2.6	*	122	=	317	2.6

Frequency of overheating $h_{\vartheta \geq Jmax}$ 5.7% **At the overheating limit ϑ_{max} = 25 °C**

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

Daily internal temperature fluctuation

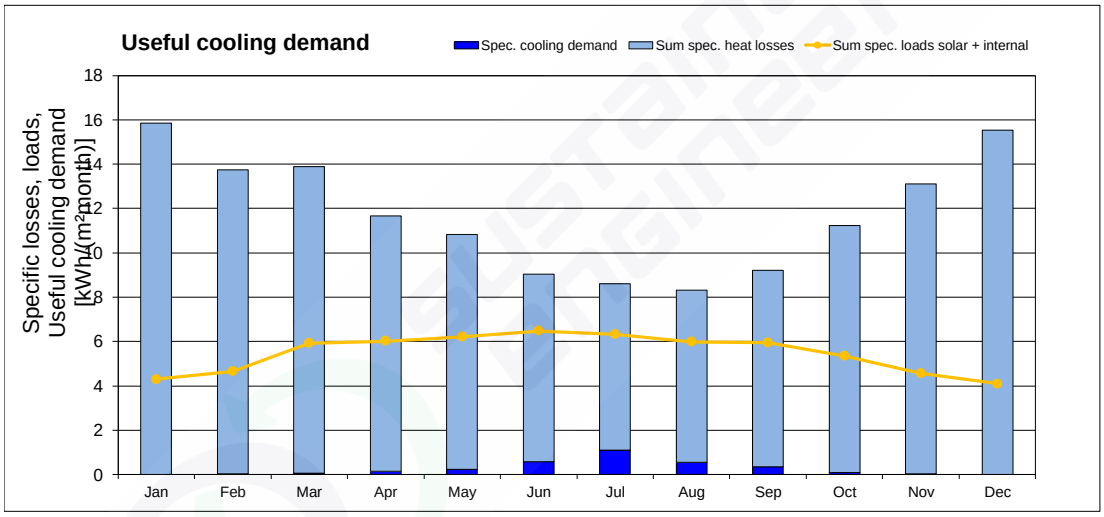
Transmission kWh/d		Ventilation kWh/d		Solar load kWh/d		1/k		Spec. capacity Wh/(m²K)		A_{TFA} m²		
(8.6	+	4.6	+	26.0	) *	1000	/ (	60	*	122	) =	5.4 K

Cooling: energy value for useful cooling energy

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Interior Temperature: 25 °C
Building type: Single Family Detached
Treated Floor Area A_{TFA}: 122 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - Exterior	14.5	12.4	12.3	10.1	9.2	7.4	6.5	6.9	7.9	10.1	12.1	14.4	124	kKh
Heating degree hours - Ground	9.1	8.6	9.5	8.8	8.4	6.7	6.2	5.9	6.5	7.1	7.5	8.5	93	kKh
Losses - Exterior	1500	1282	1268	1035	946	757	662	704	808	1043	1246	1483	12734	kWh
Losses - Ground	288	271	299	277	266	210	197	185	203	223	236	268	2922	kWh
Losses summer ventilation	142	120	115	89	79	61	52	56	66	89	113	140	1122	kWh
Sum spec. heat losses	15.9	13.7	13.8	11.5	10.6	8.4	7.5	7.8	8.9	11.1	13.1	15.5	137.8	kWh/m²
Solar load North	10	15	21	31	38	45	41	32	25	18	11	9	296	kWh
Solar load East	10	17	29	39	47	56	49	36	33	21	14	8	358	kWh
Solar load South	223	263	342	322	303	311	304	306	334	301	253	207	3469	kWh
Solar load West	7	9	14	16	18	20	19	18	15	11	7	6	162	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	36	51	80	98	115	129	121	100	87	63	42	32	954	kWh
Internal heat gains	236	213	236	228	236	228	236	236	228	236	228	236	2779	kWh
Sum spec. loads solar + internal	4.3	4.7	5.9	6.0	6.2	6.5	6.3	6.0	5.9	5.3	4.6	4.1	65.8	kWh/m²
Utilisation factor losses	27%	34%	42%	51%	56%	70%	70%	70%	63%	47%	35%	26%	46%	
Useful cooling energy demand	1	3	9	19	29	71	135	67	44	12	3	1	394	kWh
Spec. cooling demand	**0.0**	**0.0**	**0.1**	**0.2**	**0.2**	**0.6**	**1.1**	**0.6**	**0.4**	**0.1**	**0.0**	**0.0**	**3.2**	kWh/m²
Specif. dehumidification demand	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	kWh/m²
Sensible fraction	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	



Cooling: energy value for useful cooling energy

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

The sum of the cooling periods calculated through the monthly method will be presented on this side.

Building type:	Single Family Detached		Treated floor area A_{TFA}:	121.8	m²
Interior temperature summer:	25	°C	Building volume:	304	m³
Nominal humidity:	12	g/kg	Internal humidity sources:	2.2	g/(m²h)
Spec. capacity:	60	Wh/(m²K)			

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Mon. red. fac.		G_t kKh/a		kWh/a	per m² treated floor area
External wall - Ambient	A	131.8	*	0.224	*	1.00	*	124	=	3651	29.98
External wall - Ground	B		*		*	1.00	*		=		
Roof/Ceiling - Ambient	A	138.6	*	0.097	*	1.00	*	124	=	1663	13.66
Floor slab / Basement ceiling	B	138.6	*	0.218	*	1.00	*	93	=	2805	23.04
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
Garage Walls	X	23.5	*	0.292	*	0.97	*	124	=	822	6.75
Windows	A	29.1	*	0.945	*	1.00	*	124	=	3401	27.93
Exterior door	A		*		*	1.00	*		=		
Exterior TB (length/m)	A		*		*	1.00	*		=		0.00
Perimeter TB (length/m)	P	78.8	*	-0.104	*	1.00	*	124	=	-1015	-8.34
Ground TB (length/m)	B	18.8	*	0.067	*	1.00	*	93	=	116	0.96

Transmission losses Q_T (negative: heat loads) — Total 11443 kWh/a — 94.0 kWh/(m²a)

Summer ventilation

from 'SummVent' worksheet

Ventilation conductance, vent. unit

exterior $H_{V,e}$	3.7	W/K
without HR	30.1	W/K
ground $H_{V,g}$	0.0	W/K
without HR	0.0	W/K

Ventilation conductance, others

exterior	5.8	W/K

Ventilation parameter

Temperature amplitude summer	9.3	K
Minimum acceptable indoor temperature	22.0	°C
Heat capacity air	0.33	Wh/(m³K)
Supply air changes	0.30	1/h
Outdoor air changes	0.06	1/h
Window night vent. air change rate, manual @ 1K	0.04	1/h
Air changes rate due to mech., autom. controlled vent.	0.00	1/h
Specific power consumption for	0.00	Wh/m³
η_{HR}	88%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV in summer
None	
Controlled by temp.	x
Controlled by enthalpy	
Always	
	Additional ventilation
Controlled by temp.	
Controlled by humidity	x

Hygienic air change

	$n_{V,system}$ 1/h		η_{+SHX}		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective air change rate Ambient $n_{V,e}$	0.300	*(1-	0%	)*(1-	0.00	)+	0.058	=	0.358
Effective air change rate Ground $n_{V,g}$	0.300	*	0%	*(1-	0.00	)		=	0.000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	304	*	0.358	*	0.33	*	117	=	4213	34.6
Ventilation losses ground $Q_{V,e}$	304	*	0.000	*	0.33	*	0	=	0	0.0
Heat losses summer ventilation	304	*	0.076	*	0.33	*	147	=	1122	9.2

Ventilation heat losses Q_V — Total 5335 kWh/a — 43.8 kWh/(m²a)

	Q_T kWh/a		Q_V kWh/a		kWh/a	kWh/(m²a)
Total heat losses Q_L	11443	+	5335	=	16778	**137.8**

Orientation of the area	Reduction factor		g-Value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a
North	0.35	*	0.53	*	4.1	*	390	=	296
East	0.32	*	0.53	*	3.5	*	600	=	358
South	0.35	*	0.53	*	17.3	*	1072	=	3469
West	0.18	*	0.27	*	4.1	*	808	=	162
Horizontal	0.40	*	0.00	*	0.0	*	1353	=	0
Sum opaque areas									954

Available solar heat gains Q_S — Total 5238 kWh/a — 43.0 kWh/(m²a)

	kh/d		Length heat. period d/a		Spec. power q_i W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
Internal heat gains Q_I	0.024	*	365	*	2.6	*	121.8	=	2779	22.8

Sum heat loads Q_F — Q_S + Q_I = 8017 kWh/a — **65.8** kWh/(m²a)

Ratio of losses to free heat gains — Q_L / Q_F = 2.09

Utilisation factor heat losses η_G = 45%

Useful heat losses $Q_{V,n}$ — η_G * Q_L = 7623 kWh/a — **62.6** kWh/(m²a)

Useful cooling demand Q_K — Q_F - $Q_{V,n}$ = 394 kWh/a — **3** kWh/(m²a)

Recommended maximum value 15 kWh/(m²a)

Requirement met? Yes (Yes/No)

Compressor - cooling units

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Building type:	Single Family Detached		Treated floor area A_{TFA}:	121.8	m²
Interior temperature summer:	25.0	°C	Mechanical cooling:		
Nominal humidity:	12.0	g/kg	Air change rate via ventilation system with supply air:	0.3	
Internal humidity sources:	2.2	g/(m²h)			

Supply air cooling
check as appropriate

On/Off mode (check as appropriate)		
Max. cooling capacity (sensible + latent)	0.0	kW
Temperature reduction dry	0.0	K
Seasonal energy efficiency ratio	1.0	

Recirculation cooling
check as appropriate

On/Off mode (check as appropriate)		
Max. cooling capacity (sensible + latent)	0.0	kW
Volume flow rate at nominal power	0.0	m³/h
Temperature reduction dry		K
Variable air volume (check if appropriate)		
Seasonal energy efficiency ratio	1.0	

Additional dehumidification
check as appropriate

Waste heat to room (check if appropriate)		
Seasonal energy efficiency ratio	1.0	

Panel cooling
check as appropriate

Seasonal energy efficiency ratio	1.0	

	Sensible kWh/(m²a)		Latent kWh/(m²a)		COP	Electricity demand (kWh/a) kWh/(m²a)	Sensible fraction
Useful cooling total	3.2		0.0				100%
Cooling contribution by:							
Supply air cooling	(	+		) /	1.0	=	
Recirculation cooling	(	+		) /	1.0	=	
Dehumidification				/		=	0%
Remaining for panel cooling				/	1.0	=	100%
Cooling distribution				/		=	100%
Total	(0.0	+	0.0	) /		= 0.0	0%

Unsatisfied demand		**Cooling demand covered?**	(Yes/No)

Compressor - cooling units

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Humidity loads and humidity removal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Internal humidity sources	1.2	1.0	1.2	1.1	1.2	1.1	1.2	1.2	1.1	1.2	1.1	1.2	14	kWh/m²
Infiltration/Window/Extract air system	-0.7	-0.6	-0.6	-0.6	-0.5	-0.4	-0.4	-0.3	-0.4	-0.5	-0.6	-0.7	-6	kWh/m²
Supply air ventilation system	-3.5	-3.0	-3.2	-2.9	-2.7	-2.1	-2.0	-1.7	-2.0	-2.5	-2.9	-3.4	-32	kWh/m²
Summer ventilation window	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Summer ventilation mechanically	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Total humidity load	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Dehumidification by supply air cooling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Dehumidification by circulation cooling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Additional dehumidification	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Total dehumidification	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Unnecessary dehumidification	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²
Missing dehumidification	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	kWh/m²

Cooling load

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Building type: Single Family Detached

Treated floor area A_{TFA}:	121.8	m²	Spec. capacity:	60	Wh/(m²K)
Building volume:	304	m³	Nominal humidity:	12.0	g/kg
Interior temperature:	25	°C	Internal humidity sources:	2.2	g/(m²h)

Temperature:	Outdoor air	Dew point	Sky
Weather 1:	22.7 °C	14.8 °C	11.6 °C
Weather 2:	22.5 °C	14.0 °C	14.0 °C
Ground design temp.	17.1 °C	SHX	12.6 °C

Radiation:	North	East	South	West	Horizontal	
	50	180	220	200	280	W/m²
	100	225	195	245	355	W/m²

Building assembly	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
External wall - Ambient	A	131.8	0.224	1.00	-2.3	-2.5	-68	-74
External wall - Ground	B			1.00	-7.9	-7.9		
Roof/Ceiling - Ambient	A	138.6	0.097	1.00	-2.3	-2.5	-31	-33
Floor slab / Basement ceiling	B	138.6	0.218	1.00	-7.9	-7.9	-239	-239
	A			1.00	-2.3	-2.5		
	A			1.00	-2.3	-2.5		
Garage Walls	X	23.5	0.292	0.97	-2.3	-2.5	-15	-17
Windows	A	29.1	0.945	1.00	-2.3	-2.5	-63	-68
Exterior door	A			1.00	-2.3	-2.5		
Exterior TB (length/m)	A			1.00	-2.3	-2.5		
Perimeter TB (length/m)	P	78.8	-0.104	1.00	-7.9	-7.9	65	65
Ground TB (length/m)	B	18.8	0.067	1.00	-7.9	-7.9	-10	-10
Building element towards neighbour	I			1.00	3.0	3.0		
Radiation correction outdoor air			$L_{ambient}$ W/K	-4.6	-2.3	-2.5	11	12
Radiation correction sky			L_{Sky} W/K	4.5	-13.4	-11.0	-61	-50
Transmission heat load P_T						Total	**-411**	**-415**

Ventilation load	V_V m³	$n_{V,equi,fraction}$ 1/h	$n_{V,equi,fraction}$ 1/h	c_{Air} Wh/(m³K)	TempDiff 1 K	TempDiff 2 K	P_V 1 W	P_V 2 W
Exterior $P_{V,o}$	304	0.358	0.358	0.33	-2.3	-2.5	-82	-90
Ground $P_{L,e}$	304	0.000	0.000	0.33	-12.4	-12.4	0	0
Summer ventilation $P_{L,S}$	304	0.044	0.045	0.33	-5.3	-5.5	-23	-24
Ventilation heat load P_V						Total	**-105**	**-114**

Orientation of the area	Area m²	g-Value (perp. radiation)	Reduction factor (see 'Windows' worksheet)	Radiation 1 W/m²	Radiation 2 W/m²	P_T 1 W	P_T 2 W
North	4.1	0.5	0.35	68	120	51	91
East	3.5	0.5	0.32	141	195	84	117
South	17.3	0.5	0.35	219	199	709	643
West	4.1	0.3	0.18	207	244	41	49
Horizontal	0.0	0.0	0.40	280	355	0	0
Sum opaque areas						198	246
Solar load P_S					Total	**1083**	**1146**

Internal heating load P_I	Spec. power W/m²	A_{TFA} m²	P_I 1 W	P_I 2 W
	2.6	122	**317**	**317**

$P_T + P_V + P_S + P_I$	**884**	or	**934**
Cooling load P_C	**934**		W
Area specific cooling load P_C / A_{TFA}	**7.7**		W/m²

Please enter the minimum supply air temperature.		°C	
Supply air temperature without cooling $\vartheta_{Supply,Min}$	22.7 °C		22.5 °C
For comparison: cooling load, transportable through the supply air $P_{Supply;Max}$	684 W		678 W
specific:	5.6 W/m²		5.6 W/m²

Air conditioning over the supply air possible? (yes/no)

Daily internal temperature stroke

Transmission W		Ventilation W		Solar load W		Time h/d		Spec. capacity Wh/(m²K)		A_{TFA} m²		
(-411.1	+	-105.5	+	1145.7	) *	24	/ (	60	*	122	) =	**2.1** K

Dehumidific. load

from 'Cooling' worksheet

Absolute humidity exterior air	10.5	or	10.0 g/kg	Absolute humid. supply air	10.5	or	10.0 g/kg
Outdoor air mass flow	21	or	21 kg/h	Supply air mass flow	108	or	108 kg/h
Summer vent. air mass flow	16	or	16 kg/h	**Humid. load, supply air**	-161	or	-219 g/h
Humidity load, outdoor air	-55	or	-75 g/h	**Humidity load, internal**	268	or	268 g/h

Enthalpy of vaporisation Wh/kg		g/kg		Humidity load g/h		Humidity load g/h		P_D 1 W		P_D 2 W
707.639	/	1000	*	53	or	-26	=	**37**	or	**0**
Dehumidification load P_T							=	**37**		W
Area specific dehumidification load P_T / A_{TFA}							=	**0.3**		W/m²

Monthly average values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Specific cooling demand	0.0	0.0	0.1	0.2	0.2	0.6	1.1	0.6	0.4	0.1	0.0	0.0	kWh/m²
Specific dehumidification demand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	kWh/m²
Sensible fraction	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	

Minimum of sensible cooling load fraction occurred **100%**

Heat distribution and domestic hot water (DHW) system

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Interior temperature:	20	°C	Interior temperature summer:	25	°C
Building type:	Single Family Detached				
Treated floor area A_{TFA}:	122	m²			
Occupancy:	2.7	Pers			
Number of dwelling units:	1				
Annual heating demand $q_{Heating}$	1919	kWh/a	Annual useful cooling dem. q_{Cool}	394	kWh/a
Length of heating period:	190	d	Length cooling period:	365	d
Average heating load P_{ave}:	0.4	kW	Average cooling load $P_{Average}$:	0.0	kW
Marginal usability of additional heat gains:	81%		Marginal utility of additional heat losses:	3%	

Space heat distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Length of distribution pipes	L_H	m												
Nominal width of pipe		mm												
Insulation thickness		mm												
Insulation reflective coating?		-												
Thermal conductivity of insulation		W/(mK)												
Heat loss coefficient per m of insulated pipe		W/(mK)												
Insulation quality of mountings, pipe suspensions, etc.		-	1-None	1-None	1-None	1-None	1-None	1-None	1-None	1-None	1-None	1-None		
Thermal bridge supplement		W/K												
Total heating loss coefficient per m of pipe	Ψ	W/(mK)												
Temp. of the room through which the pipes pass	ϑ_X	°C	20	20	20	20	20							
Design forward flow temperature	ϑ_V	°C	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6		
Design system heating load	$P_{heating}$	kW	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		
Forward flow temperature control ('x' if appropriate)														
Design return flow temperature	ϑ_R	°C												
Annual heat emission per m of plumbing	q^*_{HL}	kWh/(m·a)												
Possible utilisation factor of released heat	η_G	-												
Annual heat losses of heating distribution	Q_{HL}	kWh/a											kWh/a	kWh/(m²a)
													0	0.0
Annual heat losses of heating storage		kWh/a											0	0.0
Annual heat losses of heating		kWh/a											0	0.0
Performance ratio of heat distribution	$ea_{,HL}$	-											100%	

DHW useful heat

DHW demand for showers, per person and day (with 60°C)		litre/person/d	16.0
DHW demand others, per person and day (with 60°C)		litre/person/d	9.0
Performance of shower drain-water heat recovery		-	0%
Effective DHW demand	V_{DHW}	litre/person/d	25
Average cold water temperature of the supply	ϑ_{TW}	°C	12.6
DHW demand for washing machines and dishwashers non-elec		kWh/a	0
Effective useful heat DHW	Q_{DHW}	kWh/a	1344

kWh/a	kWh/(m²a)
1344	11.0

Auxiliary calculation - DHW demand calculation (for non-res)

Auxiliary calculation - shower drain-water heat recovery

DHW distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Temp. of room through which the pipes pass	ϑ_X	°C	20.0	20.0	20.0	20.0	20.0	**11.6**	11.6	11.6	11.6	11.6		
Design forward flow temperature	ϑ_{dist}	°C	**60.0**	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0		
DHW circulation pipes														
Length of circulation pipes (forward + return flow)	L_{HS}	m	**17.1**					**2.00**						
Nominal width of pipe		mm	**20**					**20**						
Insulation thickness		mm	**13**					**13**						
Insulation reflective coating?		-												
Thermal conductivity of insulation		W/(mK)	**0.040**					**0.040**						
Heat loss coefficient per m of insulated pipe		W/(mK)	0.252					0.254						
Insulation quality of mountings, pipe suspensions, etc.		-	**3 - Good**	**1-None**	**1-None**	**1-None**	**1-None**	**3 - Good**	**1-None**	**1-None**	**1-None**	**1-None**		
Thermal bridge supplement		W/K	0.226					0.150						
Total heating loss coefficient per m of pipe	Ψ	W/(mK)	**0.265**					**0.329**						
Daily circulation period of operation.	td_{Circ}	h/d	**18.0**					**18.0**						
Design return flow temperature	ϑ_R	°C	55					55						
Circulation period of operation per year	t_{Circ}	h/a	6570					6570						
Annual heat released per m of pipe	q^*_Z	kWh/m/a	65					99						
Annual heat loss from circulation lines	QZ	kWh/a	**1119**					**198**					kWh/a **1317**	kWh/(m²a) **10.8**
DHW individual pipes														
Exterior pipe diameter	d_{U_Pipe}	m	**0.016**					**0.016**						
Accumulated length per single pipes	L_U	m	**48.55**					**6.00**						
Amount of tapping points in building	$n_{tapping\ poin}$	-	**6.00**					**6.00**						
Average pipe length per tapping point	$L_{U,\ average}$	m	8.1					1.0						
Tap openings per person per day		-	**6**					**6**						
Utilisation days per year		d	**365**					**365**						
Heat loss per tap opening	$q_{Individual}$	'h/tap opening	0.0565					0.0084						
Amount of tap openings per year and person	n_{Tap}	ıings per year	2190					2190						
Annual heat loss of individual pipes	Q_U	kWh/a	**331**					**50**					kWh/a **381**	kWh/(m²a) **3.1**
Total heat losses of DHW distribution	Q_{WL}												kWh/a **1698**	kWh/(m²a) **13.9**
Performance ratio of DHW distribution pipes	$ea_{,HL}$	-											**226%**	

Storage heat losses

		Storage 1	Storage 2	Buffer storage tank (only heating)	Compact unit		
Selection of storage tank		2-DHW only	0-No storage tank	0-No storage tank	0-No		
Storage necessary for HP		x		(x)			
Solar DHW connection							
Heat loss rate	W/K	2.7					
Storage volume	litre	220			---		
Standby fraction	-						
Location of storage tank, inside or outside of thermal envelope		2-Outside	1-Inside	1-Inside			
Temperature of mechanical room	°C	11.6					
Typical storage tank temperature	°C	60.0					
Manual entry of storage temperature	°C						
Average standby heat losses storage tank	W	132					
Additional heat losses storage tank, solar operation	W			---	---		
Possibly utilisation factor of heat losses		---	---		---		
Annual heat losses DHW storage tank	kWh/a	1153		---		kWh/a	kWh/(m²a)
						1153	9.5
Annual heat losses buffer storage tank		---	---		---		

Auxiliary calculation - heat losses through storage tank according to EU efficiency classes

Total energy demand of domestic hot water

		kWh/a	kWh/(m²a)
Heat losses of DHW distribution and storage	Q_{WL}	2851	23.4
Performance ratio DHW-distribution + storage	$e_{a,WL}$	312%	
Total heating demand of DHW system		kWh/a	kWh/(m²a)
Including storage tank	Q_{gDHW}	4195	34.5

Cooling distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Length of distribution pipes	L_H	m												
Nominal width of pipe		mm												
Insulation thickness		mm												
Insulation reflective coating?		-												
Thermal conductivity of insulation		W/(mK)												
Heat loss coefficient per m pipe	Ψ	W/(mK)												
Temp. of room through which the pipes pass	ϑ_X	°C	25.0	25.0	25.0	25.0	25.0	**25.0**	25.0	25.0	25.0	25.0		
Design forward flow temperature	ϑ_V	°C	**6.0**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		
Dimensioning of cooling load of the system	$P_{cooling}$	kW												
Forward flow temperature control ('x' if appropriate)														
Design return flow temperature	ϑ_R	°C												
Annual heat absorption per m of pipe	q^*_{HL}	kWh/(m·a)												
Possibly utilisation factor of this heat absorption	η_G	-												
Annual heat losses of cooling distribution	Q_{HL}	kWh/a											kWh/a: **0**	kWh/(m²a): **0.0**
Performance ratio cold water distribution pipes	$ea_{,HL}$	-											**100%**	

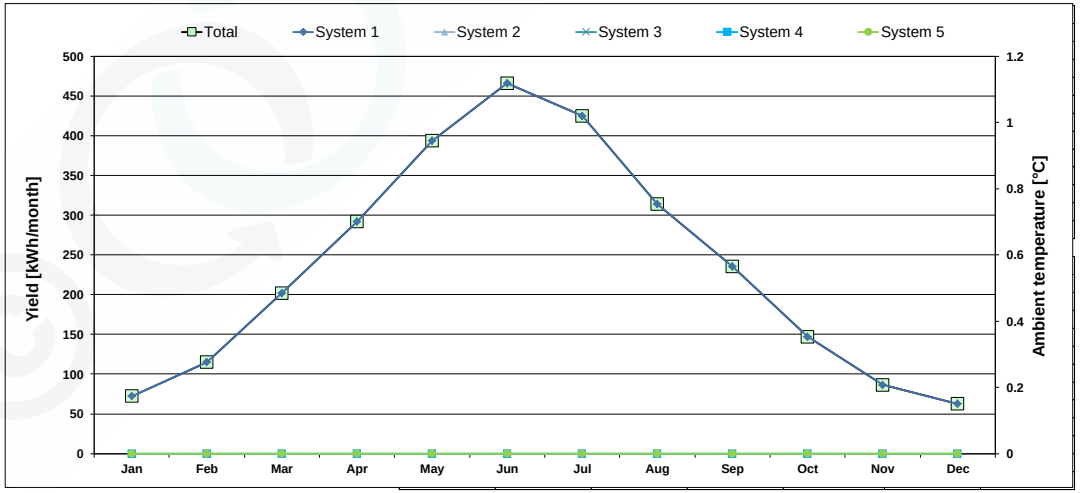
Photovoltaic systems

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Climate data set: ud---02-NZ0003b-Christchurch
Building type: Single Family Detached
Projected building footprint: 138.6 m²

		System 1	System 2	System 3	System 4	System 5	Reference PV syst.	
Name of system								
Location: Selection in 'Areas' worksheet								
Size of selected area								m²
Deviation from North		0						°
Angle of inclination from horizontal		30						°
Alternative input: Deviation from North		0						°
Alternative input: Angle of inclination from the horizontal		30						°
Information from the module data sheet								
Technology		4-Mono-Si					4-Mono-Si	
Nominal current	I_{MPP0}	9.26					7.71	A
Nominal voltage	U_{MPP0}	33.50					30.50	V
Nominal power	P_n	310	0	0	0	0	235	Wp
Temperature coefficient short-circuit current	α	0.040					0.040	%/K
Temperature coefficient open-circuit voltage	β	-0.280					-0.340	%/K
Module dimensions: Height		1.675					1.658	m
Module dimensions: Width		0.997					0.994	m
							1.6	Module area [m²]
Further specifications								
Number of modules	n_M	12					0.0	
Height of module array		4.0						m
Height of horizon	h_{Hori}							m
Horizontal distance	a_{Hori}							m
Additional reduction factor shading	r_{other}							
Efficiency of the inverter	η_{INV}	96%					95%	
Results								
Area of module field		20.0	0.0	0.0	0.0	0.0	0.0	m²
Free area on the selected building element								m²
Allocation to building element								
Annual losses due to shading		0						kWh

		Total	
Annual electricity yield after the inverter, absolute	2812	2812	kWh/a
Related to projected building footprint area	20.3	20	kWh/m²A_{Projec}
CO2-equivalent emissions according to 1-CO2 factors GEMIS (Germany)	365.5	365.5	kg/a
PE-factor according to 1-PE factors (non-renewable) PHI Certification	0.00	0.00	kWh_{prim}/kWh_{fi}



Electricity demand for residential buildings

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Households	1
Persons	2.7
Living area (m²)	122
Heating demand [kWh/(m²a)]	15.8

PER and PE factors (kWh/kWh)		
Electricity:	1.15	2.6
Non-electric energy carrier for cooking, drying:	1.15	2.6
Energy carrier for heating:	1.10	2.6
Energy carrier for DHW:	1.15	2.6

Solar fraction of DHW Laundry&Dish	
Marginal performance ratio DHW	37%
Marginal performance ratio Heating	37%

Column no.	1	2	3			4		5			6			7		8	8a		9		10		11		12		13
Application	Used ? (1/0)	Within the thermal envelope? (1/0)	Norm demand			Utilisation 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)
Dishwashing	1	1	1.10	kWh/Use		* 1.00	*	65	/(P*a)	*	2.7	P	=	192	*	100%		=	192								
2-Cold water connection															*		0%			* (1+	0.30	) *	0.37	*(1-		) =	
Clothes washing	1	1	1.10	kWh/Use		* **1.00**	*	57	/(P*a)	*	2.7	P	=	168	*	100%		=	**168**								
2-Cold water connection															*		0%			* (1+	0.05	) *	0.37	*(1-		) =	
Clothes drying with:	1	0	3.50	kWh/Use	Residual dampness	0.88	*	57	/(P*a)	*	2.7	P	=	0		0%		=	**0**								
1-Clothes line					**0.60**								=	0			0%						1.00	*			**0**
Energy consumed by evaporation	1	0	0.00	kWh/Use		* 0.60	*	57	/(P*a)	*	2.7	P	=	0	*		100%			* (1+	0.00	) *	0.37	*(1-	0.60	) =	**0**
Refrigerating	0	1	0.78	kWh/d		* 1.00	*	365	d/a	*	1	HH	=	0	*	100%		=	**0**								
Freezing	0	1	0.88	kWh/d		* 1.00	*	365	d/a	*	1	HH	=	0	*	100%		=	**0**								
or combination	1	1	1.00	kWh/d		* 1.00	*	365	d/a	*	1	HH	=	365	*	100%		=	**365**								
Cooking with:	1	1	0.25	kWh/Use		* 1.00	*	500	/(P*a)	*	2.7	P	=	335	*	100%		=	**335**								
1-Electricity					Average lamp efficiency [lm/W]										*		0%										**0**
Lighting	1	1	14	W	**50**	* 1.00	*	2.90	kh/(P*a)	*	2.7	P	=	112	*	100%		=	**112**								
Consumer electronics	1	1	**80**	W		* 1.00	*	**0.55**	kh/(P*a)	*	2.7	P	=	118	*	100%		=	**118**								
Small appliances, etc.	1	1	50	kWh		* 1.00	*	1.00	/(P*a)	*	2.7	P	=	134	*	100%		=	**134**								
Total aux. electricity														323					323								
Other:																											
				kWh/a										0					**0**								
				kWh/a										0					**0**								
				kWh/a										0					**0**								

Total										1746	kWh	**1746**	kWh
Specific demand												**14.3**	kWh/(m²a)
Recommended maximum value												18	

DHW Non-Electric - Wash&Dish

	0	kWh	**0**

Non-Renewable Non-Electric DHW Wash&Dish

	0.0	kWh/(m²a)	**0.0**

Aux Electricity

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Treated floor area	122	m²
Heating period	190	d
Air volume	304	m³
Dwelling units	1	HH

Heat recovery efficiency ventilation unit	0.88	
Operation vent. system Winter	4.57	kh/a
Operation vent. system Summer	4.19	kh/a
Air change rate	0.30	h^{-1}

Annual space heating demand	16	kWh/(m^{2}a)
Boiler rated power	15	kW
DHW system heating demand	4195	kWh/a
Design forward flow temperature	30	°C

Column no.	1	2	3		4		5		6		7		8		9		10	11
Application	Existing [1/0]	Within the thermal envelope [1/0]	Norm demand		Utilisation factor		Period of operation		Reference size		Electricity demand [kWh/a]		Available as interior heat		Utilisation period [h/a]		Internal heat gains winter [W]	Internal heat gains summer [W]
Ventilation system																		
Winter ventilation	1		0.24	Wh/m³	* 0.30	h^{-1}	* 4.6	kh/a	* 304	m³	= 101		considered in heat recovery efficiency					
Defroster HX	0	1	Data entries in 'Ventilation' worksheet or in 'Addl vent'								0	*	0.1	/	4.57	=	0	
Summer ventilation	1	0.90	0.24	Wh/m³	* 0.30	h^{-1}	* 4.2	kh/a	* 304	m³	= 92	*	1.0	/	4.19	=		20
																	Internal heat sources ' Additional summer ventilation'	0.0
Additional vent. summer	0		0.00	Wh/m³	* 0.00	h^{-1}	* 4.2	kh/a	* 304	m³	= 0	*	1.0	/	4.19	=		
Heating system			Controlled / non controlled [1/0]															
Enter the rated power of the pump				W														
Circulator pump heating			104	W	* 1.0		* 4.6	kh/a	* 1		= 0	*	1.0	/	4.57	=	0	
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	/	4.57	=	0	
Aux. energy - Wood fired/Pellet boiler	0	0	Data entries in 'Boiler' worksheet. Aux. energy demand including possible drinking water production.								0	*	1.0	/	4.57	=	0	
DHW system																		
Enter average power consumption of pump				W														
Circulation pump DHW	1		28	W	* 1.00		* 4.6	kh/a	* 1		= 130	*	1.0	/	8.76	=	0	0
Enter the rated power of the pump				W														
Storage load pump DHW			53	W	* 1.00		* 0.3	kh/a	* 1		= 0	*	1.0	/	8.76	=	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	/	8.76	=	0	0
Enter the rated power of the solar DHW pump				W														
Solar aux. electricity	0		38	W	* 1.00		* 1.8	kh/a	* 1		= 0	*	1.0	/	8.76	=	0	0
Aux. electricity cooling and dehumidification																		
Aux. electricity cooling				kWh/a	* 1.00		* 1.0		* 1		= 0	*	1.0	/	4.19	=		0
Aux. electricity dehum.				kWh/a	* 1.00		* 1.0		* 1		= 0	*	1.0	/	4.19	=		0
Misc. aux. electricity																		
Misc. aux. electricity				kWh/a	* 1.00		* 1.0		* 1		= 0	*	1.0	/	8.76	=	0	0
Total											323						0	20
Specific demand	kWh/(m²a) (treated floor area)										2.7							

Internal heat gains for residential buildings (at the moment this worksheet is inactive)

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

Utilisation: 10-Dwelling

Type of values used: 2-Standard

IHG heating 2.51 W/m²

IHG cooling 2.61 W/m²

No input is necessary

Go to utilisation pattern selection

Persons	2.7	P
Living area	122	m²

Heating demand	16	kWh/(m²a)
Heating period	190	d/a

Application	Existing [1/0] or occupancy	Within the thermal envelope [1/0]	Norm consumption		Utilisation factor	Frequency		Useful energy [kWh/a]		Included in electricity balance?		Availability		Utilisation period [h/a]		Internal heat gains [W]
Dishwashing	1	1	1.1	kWh/Use	1.00	65	/(P*a)	192	*			0.30	/	8.76	=	7
Clothes washing	1	1	1.1	kWh/Use	1.00	57	/(P*a)	168	*			0.30	/	8.76	=	6
Clothes drying with:	1	0	3.5	kWh/Use	0.88	57	/(P*a)	0	*			1.00	/	8.76	=	0
1-Clothes line		0	0.0					0				0.80				
Energy consumed by evaporation	1	0	0.0	kWh/Use	0.60	57	/(P*a)	0	* (1-	0	) *	1.00	/	8.76	=	0
Refrigerating	0	1	0.8	kWh/d	1.00	365	d/a	0	*			1.00	/	8.76	=	0
Freezing	0	1	0.9	kWh/d	1.00	365	d/a	0	*			1.00	/	8.76	=	0
or combination	1	1	1.0	kWh/d	1.00	365	d/a	365	*			1.00	/	8.76	=	42
Cooking	1	1	0.3	kWh/Use	1.00	500	/(P*a)	335	*			0.50	/	8.76	=	19
Lighting	1	1	14.4	W	1.00	2.9	kh/(P*a)	112	*			1.00	/	8.76	=	13
Consumer electronics	1	1	80.0	W	1.00	0.55	kh/(P*a)	118	*			1.00	/	8.76	=	13
Household appliances/Other	1	1	50.0	kWh	1.00	1.0	/(P*a)	134	*			1.00	/	8.76	=	15
Auxiliary appliances (cf. aux Electricity sheet)															=	0
Other applications (cf. Electricity sheet)	0	0.0						0	*				/	8.76	=	0
Persons	3	1	80.0	W/P	1.00	8.76	kh/a	1877	*			0.55	/	8.76	=	118
Cold water	3	1	-12.5	W/P	1.00	8.76	kh/a								=	-34
DHW - circulation	1	1	127.7	W	1.00	8.76	kh/a	1119	*			1.00	/	8.76	=	128
DHW - individual pipes	1	1	37.8	W	1.00	8.76	kh/a	331	*			1.00	/	8.76	=	38
DHW storage tank heating case	1	0	0.0	W	1.00	8.76	kh/a	0	*			1.00	/	8.76	=	0
DHW storage tank cooling case	1	0	0.0	W	1.00	8.76	kh/a	0	*			1.00	/	8.76	=	0
Evaporation	3	1	-25.0	W/P	1.00	8.76	kh/a	-587	*			1.00	/	8.76	=	-67
Total IHG														W		297
Specific IHG														W/m²		2.44
Heat available from internal sources										190	d/a			kWh/(m²a)		11.2

Primary Energy Renewable PER

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

				Building type:	Single Family Detached
				Treated floor area A_{TFA}:	122 m²
Selection of heat generation system(s)	**Contribution margin (useful energy)**			Projected building footprint $A_{Projected}$:	139 m²
Primary heat generation type	**Heating**	**DHW**	**Addl. input in following worksheets**	Heating demand incl. distribution & hydr. frost protection	16 kWh/(m²a)
2-Heat pump(s)	100%	100%	HP, possibly HP ground	Cooling energy dem. incl. dehumidification	kWh/(m²a)
Secondary heat generation type (optional & different)				DHW demand including distribution:	34 kWh/(m²a)
	0%	0%	-		

Energy demand / **Reference: Treated floor area**	**Efficiency** Calculation -	User defined value -	**Final energy** Contribution (final energy)	**Final energy demand** kWh/(m²a)	**PER** PER factor kWh/kWh	Effective PER factor (including biomass kWh/kWh	**PER specific value** kWh/(m²a)	**PE** PE factor kWh/kWh	PE value kWh/(m²a)	**CO_2** CO_2 emissions factor (CO_2-eq) kg/kWh	CO_2eq emissions kg/(m²a)
								1-PE factors (non-renewable) PHI Certification		1-CO2 factors GEMIS (Germany)	
							37.4		85.5		17.5
Heating			100%			1.10	**7.9**	2.60	**18.7**		**3.8**
Electricity (HP compact unit)					1.10			2.60		0.532	
Electricity (heat pump)	2.48		100%	6.4	1.10	1.10	7.0	2.60	16.5	0.532	3.4
District heating: 1-None					2.8|4.5|3.3					0.000	
Wood and other biomass					1.10			-		-	
Natural gas / RE gas					1.75			1.10		0.250	
Heating oil / RE methanol					2.30			1.10		0.320	
Solar thermal system											
Electricity (direct)					1.10			2.60		0.532	
Aux. electricity (heating, wintertime ventilation)				0.8	1.10	1.10	0.9	2.60	2.2	0.532	0.4
Cooling and dehumidification					1.00		**0.8**		**2.0**		**0.4**
Electricity cooling (heat pump)					1.00			2.60		0.532	
Auxiliary electricity cooling, ventilation summer				0.8	1.00		0.8	2.60	2.0	0.532	0.4
Electricity dehumidification (heat pump)					1.00			2.60		0.532	
Auxiliary electricity (dehumidification)					1.00			2.60		0.532	
DHW generation			100%			1.15	**15.3**	2.60	**34.5**		**7.1**
Electricity (HP compact unit)					1.15			2.60		0.532	
Electricity (heat pump)	2.82		100%	12.2	1.15	1.15	14.0	2.60	31.7	0.532	6.5
District heating: 1-None					2.8|4.5|3.3					0.000	
Wood and other biomass					1.10			-		-	
Natural gas / RE gas					1.75			1.10		0.250	
Heating oil / Methanol					2.30			1.10		0.320	
Solar thermal system											
Electricity (direct)					1.15			2.60		0.532	
Aux. electricity (DHW + solar DHW)				1.1	1.15	1.15	1.2	2.60	2.8	0.532	0.6
Household electricity				**11.7**		1.15	**13.4**		**30.4**		**6.2**
Electricity (household or non-residential lighting, etc.)				11.7	1.15	1.15	13.4	2.60	30.4	0.532	6.2
Auxiliary electricity (other)					1.15			2.60		0.532	
Gas / RE gas dry/cook				**0.0**	1.75		**0.0**	2.60	**0.0**	0.270	**0.0**

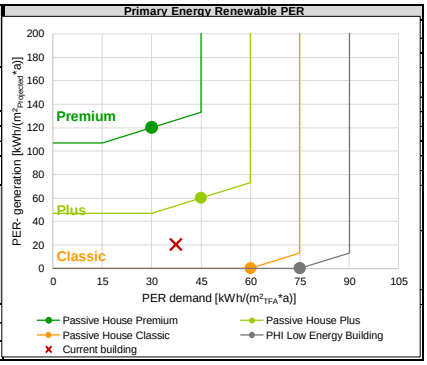
Energy generation / **Reference: Projected building footprint area**	**Final energy** Final energy generation kWh/a	**Final energy generation** kWh/(m²$A_{Projected}$*a)	**PER** PER factor kWh/kWh	**PER specific value** kWh/(m²$A_{Projected}$a)	**PE** PE factor kWh/kWh	PE Value kWh/(m²a)	**CO_2** Emission factor (CO_2-eq) kg/kWh	CO_2eq emissions kg/a
				20.3		**0.0**		**365.5**
PV electricity	2812	20.3	1.00	20.3	0.00	0.0	0.130	365.5
Solar thermal system	0	0.0	-	0.0	1.22	0.0		
		0.0						

PE demand requirement in case of verification through PE (non-renewable) [kWh/(m²a)]	-	**Current building reaches following class**	86	**Requirement met?**	-

Achievable energy standard through the verification of renewable primary energy (assessment of individual aspects)	**Useful energy, performance** Annual heat. dem. Treated floor area kWh/(m²a)	Heating load Treated floor area W/m²	Useful cool. energy Treated floor area kWh/(m²a)	Cooling load Treated floor area W/m²	**Airtightness** n_{50} 1/h
Requirement Passive House Premium					
Requirement Passive House Plus	15	10	-	-	0.60
Requirement Passive House Classic					
Requirement PHI Low Energy Building	30		-		1.00
Current building reaches following class for aspe	16	10	-	-	0.4
	Premium		Premium		Premium

Summary Though, from the scientific point of view, not entirely correct, different energy carriers will be added together here. This is done to meet the criteria of other energy standards.	**Final energy** MWh/a	**PER specific value** MWh/a	**PE value** 1-PE factors (non-renewable) PHI Certification MWh/a	**CO2eq emissions** 1-CO2 factors GEMIS (Germany) kg/a	**CO_2eq substitution balance** 1-CO2 factors GEMIS (Germany) kg/a
Demand	**4.0**	**4.5**	10.41	2131	2131
Generation	**-2.8**	**-2.8**	0.00	366	-1130
Demand, cumulative generation (annual balance)	1.19	1.74	10.41	2496	1000
Demand w/o household electricity	**2.6**	**2.9**	6.71	1374	1374
Demand w/o household electricity, cum. generation	-0.23	0.10	6.71	1739	243

Primary Energy Renewable PER



Heat pump

Martin Residence / Climate: NZ0003b-Christchurch / TFA: 122 m² / Heating: 15.8 kWh/(m²a) / Freq. overheating: 6 % / PER: 37.4 kWh/(m²a)

			Building type:	Single Family Detached	
			Treated floor area A_{TFA}:	122	m²
Covered fraction of space heating demand		*('PER' worksheet)*		100%	
Space heating demand + distribution losses	Q_H+Q_{HL}:	*(DHW+Distribution)*		1919	kWh/a
Solar fraction for space heat	$\eta_{Solar,\ H}$	*('SolarDHW' worksheet)*		0%	
Effective annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$			**1919**	kWh/a
Covered fraction of DHW demand		*('PER' worksheet)*		100%	
Total heating demand of DHW system	Q_{gDHW}	*(DHW+Distribution)*		4195	kWh/a
Solar fraction for DHW	$\eta_{Solar,\ DHW}$	*('SolarDHW' worksheet)*		0%	
Effective DHW demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$			**4195**	kWh/a
Number of heat pumps in the system				1	
Functionality				Heating & DHW	
Heating					
Selection of HP: 4-Misubishi MSZ-GL50VGD			Heat source:	1-Outdoor air	
Selection of distribution system				2-Radiators	
Design distribution temperature	θ_{design}	*(DHW+Distribution)*		29.61	°C
Nominal power of distribution system	P_{nom}			1.19	kW
Distribution system (to be completed by experienced users only)					
Nominal power of distribution system	P_{nom}				kW
Radiator exponent	n				
Heat storage tank (buffer storage tank 'DHW+Distribution' worksheet)				0-No	
Specific heat losses storage	U * A $_{Storage}$				W/K
Storage location in thermal envelope				1-Inside	
Room temperature (storage location: outside of thermal envelope)		*(DHW+Distribution)*			°C
Sink temperature of heat pump for heating	θ_{snk}			61.50	°C
Entries in relation to the domestic hot water system					
Selection of HP: 1-Standard air/water heat pump			Heat source:	1-Outdoor air	
DHW temperature		*(DHW+Distribution)*		60.00	°C
Orientation of DHW storage tank ('storage 1' in 'DHW+Distribution' worksheet)				2-Outside	
Specific heat losses storage	U * A $_{Storage}$			2.7	W/K
Room temperature (storage location: outside of thermal envelope)		*(DHW+Distribution)*		11.60	°C
Type of backup heater				1-Elec. Immersion heater	
Δθ of electric continuous flow water heater					K
Additional options in case of <u>one</u> heat pump for both functions: Heating & DHW					
Same heat pump's sink temperature for Heating and for DHW				1-Yes	
Heat pump priority		*(Manufacturer, tech. data)*		1-DHW-priority	
Control strategy					
Heat pump control strategy				1-On/Off	
Heating					
Depth ground water / Ground collector / Ground probe	z				m
Power of pump for ground heat exchanger	P_{pump}				kW