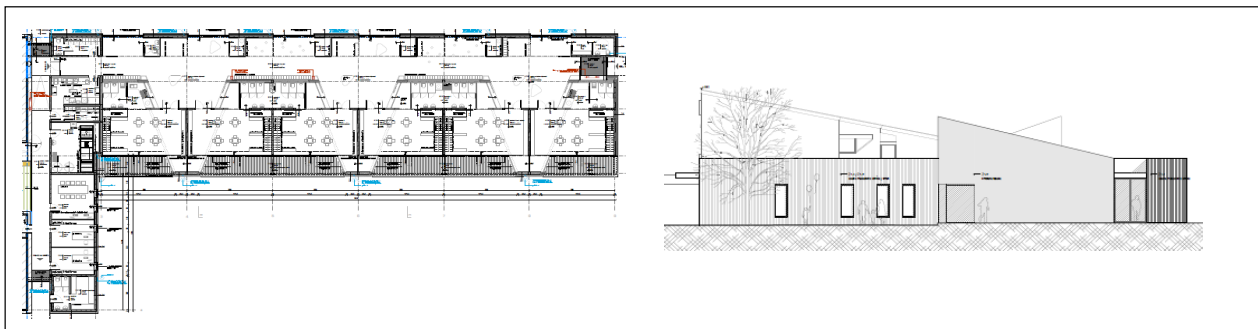


# Passive House Verification



Building:	Vrtec ROGATEC	
Location and Climate:	ROGATEC	Ljubljana 2014
Street:		
Postcode/City:		
Country:	Slovenija	
Building Type:	P+M	
Home Owner(s) / Client(s):	OBČINA ROGATEC	
Street:	Pot k ribniku 4	
Postcode/City:	3252 Rogatec	
Architect:	MODULAR arhitekti d.o.o.	
Street:	Grudnovo nabrežje 23	
Postcode/City:	1000 Ljubljana	
Mechanical System:		
Street:		
Postcode/City:		
Year of Construction:	2017	
Number of Dwelling Units:	1	
Enclosed Volume $V_e$ :	4210,0	$m^3$
Number of Occupants:	120,0	
Interior Temperature:	20,0	$^{\circ}C$
Internal Heat Gains:	2,8	$W/m^2$

Specific Demands with Reference to the Treated Floor Area					
Treated Floor Area:					
Treated Floor Area:		918,7	$m^2$		
Applied:		Monthly Method	PH Certificate:	Fulfilled?	
<b>Specific Space Heat Demand:</b>	<b>14,8</b>	<b>kWh/(m<sup>2</sup>a)</b>	<b>3,68</b>	<b>15 kWh/(m<sup>2</sup>a)</b>	<b>Yes</b>
<b>Pressurization Test Result:</b>	<b>0,6</b>	<b>h<sup>-1</sup></b>		0,6 h <sup>-1</sup>	<b>Yes</b>
<b>Specific Primary Energy Demand</b> (DHW, Heating, Cooling, Auxiliary and Household Electricity):	<b>78</b>	<b>kWh/(m<sup>2</sup>a)</b>		120 kWh/(m <sup>2</sup> a)	<b>Yes</b>
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	78	kWh/(m <sup>2</sup> a)			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m <sup>2</sup> a)			
Heating Load:	14	W/m <sup>2</sup>			
Frequency of Overheating:	2	%	over	25 $^{\circ}C$	
Specific Useful Cooling Energy Demand:		kWh/(m <sup>2</sup> a)		15 kWh/(m <sup>2</sup> a)	
Cooling Load:	5	W/m <sup>2</sup>			

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

Issued on:

jan.17

signed:

Simon BRLEK

# Passive House Planning

## AREAS DETERMINATION

Building: Vrtec ROGATEC

Heat Demand: 15 kWh/(m<sup>2</sup>a)

Summary							Building Element Overview	Average U-Value [W/(m <sup>2</sup> K)]
Group Nr.	Area Group	Temp Zone	Area	Unit	Comments			
1	Treated Floor Area		918,70	m <sup>2</sup>	Living area or useful area within the thermal envelope			
2	North Windows	A	61,74	m <sup>2</sup>	Results are from the Windows worksheet.	North Windows	0,737	
3	East Windows	A	20,91	m <sup>2</sup>		East Windows	0,859	
4	South Windows	A	105,07	m <sup>2</sup>		South Windows	0,762	
5	West Windows	A	26,93	m <sup>2</sup>		West Windows	0,851	
6	Horizontal Windows	A	12,66	m <sup>2</sup>		Horizontal Windows	1,028	
7	Exterior Door	A	9,90	m <sup>2</sup>		Please subtract area of door from respective building element	Exterior Door	1,000
8	Exterior Wall - Ambient	A	847,83	m <sup>2</sup>	Window areas are subtracted from the individual areas specified in the "Windows" worksheet.	Exterior Wall - Ambient	0,115	
9	Exterior Wall - Ground	B	0,00	m <sup>2</sup>	Temperature Zone "A" is ambient air.	Exterior Wall - Ground		
10	Roof/Ceiling - Ambient	A	877,84	m <sup>2</sup>	Temperature zone "B" is the ground.	Roof/Ceiling - Ambient	0,104	
11	Floor Slab	B	961,68	m <sup>2</sup>		Floor Slab	0,150	
12			0,00	m <sup>2</sup>	Temperature zones "A", "B", "P" and "X" may be used. NOT "I"			
13			0,00	m <sup>2</sup>	Temperature zones "A", "B", "P" and "X" may be used. NOT "I"			
14		X	0,00	m <sup>2</sup>	Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):	Factor for X	75%	
							Thermal Bridge Overview	Ψ [W/(mK)]
15	Thermal Bridges Ambient	A	0,00	m	Units in m	Thermal Bridges Ambient		
16	Perimeter Thermal Bridges	P	120,00	m	Units in m; temperature zone "P" is perimeter (see Ground worksheet).	Perimeter Thermal Bridges	0,040	
17	Thermal Bridges Floor Slab	B	0,00	m	Units in m	Thermal Bridges Floor Slab		
18	Partition Wall to Neighbour	I	100,89	m <sup>2</sup>	No heat losses, only considered for the heat load calculation.	Partition Wall to Neighbour	0,125	
<b>Total Thermal Envelope</b>			<b>2924,57</b>	<b>m<sup>2</sup></b>		<b>Average Therm. Envelope</b>	<b>0,180</b>	

Area Input													Selection of the Corresponding Building Element Assembly	Nr.	U-Value [W/(m <sup>2</sup> K)]				
Area Nr.	Building Element Description	Group Nr.	Assigned to Group	Quantity	x (	a [m]	x	b [m]	+	User-Determined [m <sup>2</sup> ]	-	User Subtraction [m <sup>2</sup> ]				-	Subtraction Window Areas [m <sup>2</sup> ]	) =	Area [m <sup>2</sup> ]
	Treated Floor Area	1	Treated Floor Area	1	x (		x		+	918,70	-		-		) =	918,7			
	North Windows	2	North Windows													61,7	From Windows sheet	0,737	
	East Windows	3	East Windows													20,9	From Windows sheet	0,859	
	South Windows	4	South Windows													105,1	From Windows sheet	0,762	
	West Windows	5	West Windows													26,9	From Windows sheet	0,851	
	Horizontal Windows	6	Horizontal Windows													12,7	From Windows sheet	1,028	
	Exterior Door	7	Exterior Door	3	x (	1,10	x	3,00	+		-		-		) =	9,9	U-Value Exterior Door	1,00	
1	Sp - Zunanja stena	8	Exterior Wall - Ambient	1	x (	58,90	x	4,30	+		-	3,00	-	67,4	) =	182,8	Z1.1-Zunanja stena - lesena k	1	0,107
2	Sml - Zunanja stena	8	Exterior Wall - Ambient	6	x (	4,40	x	1,00	+		-		-	0,0	) =	26,4	Z1.1-Zunanja stena - lesena k	1	0,107
3	Sm2 - Zunanja stena	8	Exterior Wall - Ambient	3	x (	8,00	x	4,00	+		-		-	0,0	) =	96,0	Z1.3-Lesena stena s kontaktno	3	0,148
4	Vp1 - Zunanja stena	8	Exterior Wall - Ambient	1	x (	13,15	x	4,30	+		-	8,00	-	0,0	) =	48,5	Z1.1-Zunanja stena - lesena k	1	0,107
5	JVp - terase	8	Exterior Wall - Ambient	3	x (	2,50	x	3,20	+		-		-	13,9	) =	10,1	Z1.1-Zunanja stena - lesena k	1	0,107
6	Vp2 - zunanja stena pisarn	8	Exterior Wall - Ambient	1	x (	17,05	x	4,30	+		-		-	7,0	) =	66,3	Z1.1-Zunanja stena - lesena k	1	0,107
7	Vm - zunanja stena	8	Exterior Wall - Ambient	1	x (	10,45	x	2,20	+		-		-	0,0	) =	23,0	Z1.1-Zunanja stena - lesena k	1	0,107
8	Jp - igralnice	8	Exterior Wall - Ambient	6	x (	7,00	x	4,00	+		-		-	97,0	) =	71,0	Z1.1-Zunanja stena - lesena k	1	0,107
9	Jp - zunanja stena terasa	8	Exterior Wall - Ambient	3	x (	2,80	x	2,80	+		-		-	2,4	) =	21,1	Z1.2-Zunanja AB stena	2	0,226
10	Jp - zunanja stena pisarne	8	Exterior Wall - Ambient	1	x (	4,80	x	4,30	+		-		-	0,0	) =	20,6	Z1.1-Zunanja stena - lesena k	1	0,107
11	Jm - zunanja stena	8	Exterior Wall - Ambient	3	x (	15,90	x	4,30	+	4,70	-		-	0,0	) =	219,2	Z1.1-Zunanja stena - lesena k	1	0,107
12	JZp - zunanja stena	8	Exterior Wall - Ambient	3	x (	2,50	x	3,20	+		-		-	13,9	) =	10,1	Z1.1-Zunanja stena - lesena k	1	0,107
13	Zp-stena proti hodniku	18	Partition Wall to Neighbour	1	x (	26,50	x	4,30	+		-		-	13,1	) =	100,9	Zn 4 - stena proti obstoječem	8	0,125
14	Zp - zunanja stena (J)	8	Exterior Wall - Ambient	1	x (	3,50	x	4,30	+		-		-	0,0	) =	15,1	Z1.1-Zunanja stena - lesena k	1	0,107
15	Zp - zunanja stena (S)	8	Exterior Wall - Ambient	1	x (	1,00	x	4,30	+		-		-	0,0	) =	4,3	Z1.1-Zunanja stena - lesena k	1	0,107
16	Zm - zunanja stena	8	Exterior Wall - Ambient	1	x (	10,45	x	2,20	+		-		-	0,0	) =	23,0	Z1.1-Zunanja stena - lesena k	1	0,107

# Passive House Planning

## AREAS DETERMINATION

 Building: 

 Heat Demand  kWh/(m<sup>2</sup>a)

Summary							Building Element Overview	Average U-Value [W/(m <sup>2</sup> K)]
Group Nr.	Area Group	Temp Zone	Area	Unit	Comments			
1	Treated Floor Area		918,70	m <sup>2</sup>	Living area or useful area within the thermal envelope			
2	North Windows	A	61,74	m <sup>2</sup>	Results are from the Windows worksheet.	North Windows	0,737	
3	East Windows	A	20,91	m <sup>2</sup>		East Windows	0,859	
4	South Windows	A	105,07	m <sup>2</sup>		South Windows	0,762	
5	West Windows	A	26,93	m <sup>2</sup>		West Windows	0,851	
6	Horizontal Windows	A	12,66	m <sup>2</sup>		Horizontal Windows	1,028	
7	Exterior Door	A	9,90	m <sup>2</sup>		Please subtract area of door from respective building element	Exterior Door	1,000
8	Exterior Wall - Ambient	A	847,83	m <sup>2</sup>	Window areas are subtracted from the individual areas specified in the "Windows" worksheet.	Exterior Wall - Ambient	0,115	
9	Exterior Wall - Ground	B	0,00	m <sup>2</sup>	Temperature Zone "A" is ambient air.	Exterior Wall - Ground		
10	Roof/Ceiling - Ambient	A	877,84	m <sup>2</sup>	Temperature zone "B" is the ground.	Roof/Ceiling - Ambient	0,104	
11	Floor Slab	B	961,68	m <sup>2</sup>		Floor Slab	0,150	
12			0,00	m <sup>2</sup>	Temperature zones "A", "B", "P" and "X" may be used. NOT "I"			
13			0,00	m <sup>2</sup>	Temperature zones "A", "B", "P" and "X" may be used. NOT "I"	Factor for X		
14		X	0,00	m <sup>2</sup>	Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):	75%		
							Thermal Bridge Overview	Ψ [W/(mK)]
15	Thermal Bridges Ambient	A	0,00	m	Units in m	Thermal Bridges Ambient		
16	Perimeter Thermal Bridges	P	120,00	m	Units in m; temperature zone "P" is perimeter (see Ground worksheet).	Perimeter Thermal Bridges	0,040	
17	Thermal Bridges Floor Slab	B	0,00	m	Units in m	Thermal Bridges Floor Slab		
18	Partition Wall to Neighbour	I	100,89	m <sup>2</sup>	No heat losses, only considered for the heat load calculation.	Partition Wall to Neighbour	0,125	
<b>Total Thermal Envelope</b>			<b>2924,57</b>	<b>m<sup>2</sup></b>		<b>Average Therm. Envelope</b>	<b>0,180</b>	

17	Vm - zunanja stena-streha	8	Exterior Wall - Ambient	3	x (	x	+	1,70	-	) -	0,0	=	5,1	Z1.3-Lesena stena s kontaktrc	3	0,148
18	Zm - zunanja stena-streha	8	Exterior Wall - Ambient	3	x (	x	+	1,70	-	) -	0,0	=	5,1	Z1.3-Lesena stena s kontaktrc	3	0,148
19	Streha-ravna prodec	10	Roof/Ceiling - Ambient	1	x (	x	+	472,30	-	) -	1,6	=	470,7	S1-Streha-prodec	4	0,104
20	Streha poševna (J)	10	Roof/Ceiling - Ambient	3	x (	7,00	x	4,20	+	) -	0,0	=	88,2	S2-Streha-poševna	5	0,105
21	Streha poševna (S)	10	Roof/Ceiling - Ambient	6	x (	10,00	x	5,50	+	) -	11,0	=	319,0	S2-Streha-poševna	5	0,105
22	Tla proti terenu igralnice	11	Floor Slab	1	x (	x	+	705,00	-	) -	0,0	=	705,0	T1.1 Tla proti terenu	6	0,151
23	Tla proti terenu pisarne	11	Floor Slab	1	x (	x	+	159,00	-	) -	0,0	=	159,0	T1.1 Tla proti terenu	6	0,151
24	Tla mansarde-previs	11	Floor Slab	3	x (	14,80	x	2,20	+	) -	0,0	=	97,7	T2.1 Tla mansarde-previs	7	0,147

# Passive House Planning

## U-VALUES OF BUILDING ELEMENTS

Building:

Wedge Shaped Building Element Layers and  
Still Air Spaces -> Secondary Calculation to the Right

1   Z1.1-Zunanja stena - lesena konstrukcija						
Assembly No. Building Assembly Description						
Heat Transfer Resistance [m <sup>2</sup> K/W] interior R <sub>si</sub> : <input type="text" value="0,13"/>						
exterior R <sub>se</sub> : <input type="text" value="0,04"/>						
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1. lesena obloga	0,140					20
2. Lesno-vlaknena plošča	0,038			Les-konstrukcija	0,130	60
3. OSB	0,130					15
4. Lesno-vlaknena plošča	0,038	Les-konstrukcija	0,130			160
5. Fermacell	0,400					15
6. Lesno-vlaknena plošča	0,038			Les-konstrukcija	0,130	180
7. lesena fasadna obloga						
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		<input type="text" value="15,0%"/>		<input type="text" value="8,0%"/>		<input type="text" value="45,0"/> cm
U-Value: <input type="text" value="0,107"/> W/(m <sup>2</sup> K)						

2   Z1.2-Zunanja AB stena						
Assembly No. Building Assembly Description						
Heat Transfer Resistance [m <sup>2</sup> K/W] interior R <sub>si</sub> : <input type="text" value="0,13"/>						
exterior R <sub>se</sub> : <input type="text" value="0,04"/>						
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1. apneni omet	0,800					25
2. AB zid	2,040					250
3. lesno-vlaknena plošča	0,038	Les-konstrukcija	0,130			180
4. folija	0,200					1
5. lesena podkonstrukcija						
6. lesena fasada						
7.						
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		<input type="text" value="7,0%"/>				<input type="text" value="45,6"/> cm
U-Value: <input type="text" value="0,226"/> W/(m <sup>2</sup> K)						

3   Z1.3-Lesena stena s kontaktno fasado						
Assembly No. Building Assembly Description						
Heat Transfer Resistance [m <sup>2</sup> K/W] interior R <sub>si</sub> : <input type="text" value="0,13"/>						
exterior R <sub>se</sub> : <input type="text" value="0,04"/>						
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1. Vidna CLT stena	0,140					180
2. lesno-vlaknena plošča	0,038	Les-konstrukcija	0,130			220
3. zračni sloj	0,250					30
4. protivetrna folija	0,200					1
5. lesena konstrukcija						
6. lesena fasada						
7.						
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		<input type="text" value="6,0%"/>				<input type="text" value="43,1"/> cm
U-Value: <input type="text" value="0,148"/> W/(m <sup>2</sup> K)						

4   S1-Streha-prodec						
Assembly No. Building Assembly Description						
Heat Transfer Resistance [m <sup>2</sup> K/W] interior R <sub>si</sub> : <input type="text" value="0,10"/>						
exterior R <sub>se</sub> : <input type="text" value="0,04"/>						
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1. akustičen spuščeni str	0,300					20
2. zračni sloj	2,750			kov. podkonstrukcija		450
3. mavčne plošče	0,400					15
4. lesno-vlaknene plošče	0,038	les-konstrukcija	0,130			80
5. parna zapora	0,250					1
6. lesno-vlaknene plošče	0,038	les-konstrukcija	0,130			340
7. dekse	0,250					20
8. zračni sloj	0,230					40
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		<input type="text" value="10,0%"/>				<input type="text" value="96,6"/> cm
U-Value: <input type="text" value="0,104"/> W/(m <sup>2</sup> K)						

# Passive House Planning

## U-VALUES OF BUILDING ELEMENTS

Wedge Shaped Building Element Layers and

Building: **Vrtec ROGATEC**

Still Air Spaces -> Secondary Calculation to the Right

5 S2-Streha-poševna						
Assembly No. Building Assembly Description						
		Heat Transfer Resistance [m <sup>2</sup> K/W]		interior R <sub>si</sub> :		0,10
				exterior R <sub>se</sub> :		0,04
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness (mm)
1. akustičen spušen str.	0,300					13
2. zračni sloj	2,750			kov. podkonstrukcija		450
3. OSB	0,040					22
4. lesno-vlakenne plošča	0,039	les-konstrukcija	0,130			80
5. parna zapora	0,200					2
6. lesno-vlakenne plošča	0,039	les-konstrukcija	0,130			320
7. deske	0,140					20
8. paroprepustna folija	0,200					1
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		10,0%				<b>90,8</b> cm
<b>U-Value: 0,105</b> W/(m <sup>2</sup> K)						

6 T1.1 Tla proti terenu						
Assembly No. Building Assembly Description						
		Heat Transfer Resistance [m <sup>2</sup> K/W]		interior R <sub>si</sub> :		0,17
				exterior R <sub>se</sub> :		0,00
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness (mm)
1. parket	0,150					15
2. cementni estrih	1,600					60
3. EPS	0,036					30
4. EPS grafit	0,032					40
5. AB plošča	2,040					300
6. XPS	0,035					140
7. hidroizolacija	0,200					10
8. podložni beton	1,800					100
		Percentage of Sec. 2		Percentage of Sec. 3		Total
						<b>69,5</b> cm
<b>U-Value: 0,151</b> W/(m <sup>2</sup> K)						

7 T2.1 Tla mansarde-previs						
Assembly No. Building Assembly Description						
		Heat Transfer Resistance [m <sup>2</sup> K/W]		interior R <sub>si</sub> :		0,17
				exterior R <sub>se</sub> :		0,04
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness (mm)
1. XLAM	0,130					160
2. folija	0,200					2
3. Weber plus ultra	0,022					80
4. Agepan THD	0,047					80
5. fasada	0,700					10
6.						
7.						
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
						<b>33,2</b> cm
<b>U-Value: 0,147</b> W/(m <sup>2</sup> K)						

8 Zn 4 - stena proti obstoječem delu						
Assembly No. Building Assembly Description						
		Heat Transfer Resistance [m <sup>2</sup> K/W]		interior R <sub>si</sub> :		0,13
				exterior R <sub>se</sub> :		0,13
Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness (mm)
1. mavčna plošča	0,400					25
2. TI (npr DP 5)	0,040					150
3. fasada	0,500					10
4. obstoječa TI	0,040					150
5. AB stena	2,040					200
6. omet	0,700					20
7.						
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
						<b>55,5</b> cm
<b>U-Value: 0,125</b> W/(m <sup>2</sup> K)						

# Passive House Planning

## HEAT LOSSES VIA THE GROUND

Ground Characteristics			
Thermal Conductivity	$\lambda$	2,0	W/(mK)
Heat Capacity	$\rho c$	2,0	MJ/(m³K)
Periodic Penetration Depth	$\delta$	3,17	m

Climate Data			
Av. Indoor Temp. Winter	$T_i$	20,0	°C
Av. Indoor Temp. Summer	$T_i$	25,0	°C
Average Ground Surface Temperature	$T_{g,ave}$	11,9	°C
Amplitude of $T_{g,ave}$	$T_{g,\Delta}$	10,4	°C
Length of the Heating Period	n	6,7	months
Heating Degree Hours - Exterior	$G_e$	73,7	kKh/a

Building Data				Floor Slab U-Value			
Floor Slab Area	A	823,0	m²	Floor Slab U-Value	$U_f$	0,150	W/(m²K)
Floor Slab Perimeter	P	120,0	m	Thermal Bridges at Floor Slab	$\Psi_{B,*1}$	0,00	W/K
Charact. Dimension of Floor Slab	$B'$	13,72	m	Floor Slab U-Value incl. TB	$U_f'$	0,150	W/(m²K)
				Eq. Thickness Floor	$d_f$	13,3	m

Floor Slab Type (select only one)			
<input type="checkbox"/>	Heated Basement or Underground Floor Slab	<input type="checkbox"/>	Unheated basement
<input checked="" type="checkbox"/>	Slab on Grade	<input type="checkbox"/>	Suspended Floor

For Basement or Underground Floor Slab							
Basement Depth	z	0,00	m	U-Value Belowground Wall	$U_{WB}$		W/(m²K)
Additionally for Unheated Basements				Height Aboveground Wall	h		m
Air Change Unheated Basement	n	0,00	h⁻¹	U-Value Aboveground Wall	$U_W$		W/(m²K)
Basement Volume	V		m³	U-Value Basement Floor Slab	$U_{fB}$		W/(m²K)

For Perimeter Insulation for Slab on Grade			
Perimeter Insulation Width/Depth	D	0,40	m
Perimeter Insulation Thickness	$d_n$	0,12	m
Conductivity Perimeter Insulation	$\lambda_n$	0,040	W/(mK)
Location of the Perimeter Insulation	horizontal	<input type="checkbox"/>	
(check only one field)	vertical	<input checked="" type="checkbox"/>	

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

Additional Thermal Bridge Heat Losses at Perimeter							
Phase Shift	$\beta$		months	Steady-State Fraction	$\Psi_{P,stat,*1}$	4,800	W/K
				Harmonic Fraction	$\Psi_{P,harm,*1}$	4,800	W/K

Groundwater Correction							
Depth of the Groundwater Table	$z_w$		m	Transm. Belowground El. (w/o Ground)	$L_{reg}$	128,39	W/K
Groundwater Flow Rate	$q_w$		m/d	Relative Insulation Standard	$d_f/B'$	0,93	-
Groundwater Correction Factor	$G_w$		-	Relative Groundwater Depth	$z_w/B'$	0,00	-
				Relative Groundwater Velocity	$I/B'$		-

Basement or Underground Floor Slab							
Eq. Thickness Floor Slab	$d_t$		m	Phase Shift	$\beta$		months
U-Value Floor Slab	$U_{bf}$		W/(m²K)	Exterior Periodic Transmittance	$L_{pe}$		W/K
Eq. Thickness Basement Wall	$d_w$		m				
U-Value Wall	$U_{bw}$		W/(m²K)				
Steady-State Transmittance	$L_S$		W/K				

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

Slab on Grade							
Heat Transfer Coefficient	$U_0$	0,10	W/(m²K)	Phase Shift	$\beta$	1,41	months
Eq. Ins. Thickness Perimeter Ins.	$d'$	5,88	m	Exterior Periodic Transmittance	$L_{pe}$	17,75	W/K
Perimeter Insulation Correction	$\Delta\Psi$	-0,01	W/(mK)				
Steady-State Transmittance	$L_S$	82,90	W/K				

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

Interim Results							
Phase Shift	$\beta$	1,41	months	Steady-State Heat Flow	$\Phi_{stat}$	712,6	W
Steady-State Transmittance	$L_S$	87,70	W/K	Periodic Heat Flow	$\Phi_{harm}$	96,3	W
Exterior Periodic Transmittance	$L_{pe}$	22,55	W/K	Heat Losses During Heating Period	$Q_{tot}$	3970	kWh

Ground Reduction Factor for "Annual Heat Demand" Sheet 0,420

### Monthly Average Ground Temperatures for Monthly Method

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average Val
Winter	13,1	12,7	12,7	13,2	14,1	15,0	15,8	16,2	16,2	15,7	14,8	13,9	14,4
Summer	14,7	14,3	14,3	14,8	15,6	16,6	17,4	17,8	17,8	17,3	16,4	15,5	16,0

Design Ground Temperature for Heat Load Sheet 12,7

for Cooling Load Sheet 17,8

# Passive House Planning

## REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: Vrtec ROGATEC

Annual Heat Demand: 15 kWh/(m²a)

Heating Degree Hour

Climate: Ljubljana 2014		g-Value		Reduction Factor for Solar Radiation		Window Area		Window U-Value		Average Global Radiation	
Window Area Orientation	Global Radiation (Cardinal Points)	Shading	Dirt	Non-Perpendicular Incident Radiation	Glazing Fraction	g-Value	Reduction Factor for Solar Radiation	Window Area	Window U-Value	Glazing Area	Average Global Radiation
maximum:	kWh/(m²a)	0,75	0,95	0,85				m²	W/(m²K)	m²	kWh/(m²a)
North	108	0,92	0,95	0,85	0,882	0,50	0,66	61,74	0,74	54,5	108
East	228	0,71	0,95	0,85	0,765	0,50	0,44	20,91	0,86	16,0	293
South	431	0,76	0,95	0,85	0,850	0,50	0,52	105,07	0,76	89,4	431
West	248	0,76	0,95	0,85	0,807	0,50	0,50	26,93	0,85	21,7	294
Horizontal	369	0,98	0,95	0,85	0,686	0,50	0,54	12,66	1,03	8,7	435
Total or Average Value for All Windows.						0,50	0,55	227,32	0,79	190,3	

73,7	
Transmission Losses	Heat Gains Solar Radiation
kWh/a	kWh/a
3352	2196
1323	1337
5900	11856
1689	1960
959	1489
13223	18838

Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Window Rough Openings		Installed		Glazing		Frame		g-Value		U-Value		Window Frame Dimensions				Installation				Ψ-Value		Results			
					Width	Height	in Area in the Areas worksheet	Nr.	Select glazing from the WinType worksheet	Nr.	Select window from the WinType worksheet	Nr.	Perpendicular Radiation	Glazing	Frames	Width - Left	Width - Right	Width - Below	Width - Above	Left 1/0	Right 1/0	Sill 1/0	Head 1/0	Ψ <sub>Spacer</sub>	Ψ <sub>Installation</sub>	Window Area	Glazing Area	U-Value Window	Glazed Fraction per Window	
		Degrees	Degrees		m	m	Select:	Select:	Select:	Nr.	W/(m²K)	W/(m²K)	m	m	m	m							W/(mK)	W/(mK)	m²	m²	W/(m²K)	%		
3	JV p fix	120	90	East	1,880	2,460	Jvp - terase	5	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	13,9	11,53	0,80	0,83	
3	JZ p fix	240	90	West	1,880	2,460	JZp - zunanja stena	12	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	13,9	11,53	0,80	0,83	
6	J p fix	180	90	South	5,370	2,460	Jp - igralnice	8	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	0	0	1	1	0,040	0,010	79,3	70,38	0,72	0,89	
6	J p	180	90	South	1,200	2,460	Jp - igralnice	8	Steklo 0,5/0,6	4	Okno	1	0,50	0,60	1,24	0,12	0,12	0,12	0,12	0	0	1	1	0,040	0,010	17,7	12,93	0,87	0,73	
4	Vp -pisarne	90	90	East	0,800	2,200	Vp2 - zunanje stene	6	Steklo 0,5/0,6	4	Okno	1	0,50	0,60	1,24	0,12	0,12	0,12	0,12	1	1	1	1	0,040	0,010	7,0	4,47	0,98	0,64	
6	S p fix	0	90	North	2,450	4,200	Sp - Zunanja stena	1	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	61,7	54,48	0,74	0,88	
2	svetlobnik	180	0	Horizontal	0,900	0,900	Streha-ravna proc.	19	Steklo 0,5/0,5	3	Velux	3	0,50	0,50	1,50	0,08	0,08	0,08	0,08	1	1	1	1	0,040	0,020	1,6	1,10	1,06	0,68	
12	strešna okna	180	15	Horizontal	0,780	1,180	Streha poševna	21	Steklo 0,5/0,5	3	Velux	3	0,50	0,50	1,50	0,08	0,08	0,08	0,08	1	1	1	0	0,040	0,020	11,0	7,59	1,02	0,69	
4	Zp - atrij	270	90	West	1,360	2,400	Zp-stena proti hoc	13	Steklo 0,5/0,6	4	Alu okno	4	0,50	0,60	1,50	0,10	0,10	0,10	0,10	1	0	1	1	0,040	0,020	13,1	10,21	0,91	0,78	
1	vrata J	180	90	South	0,800	3,000	Jp - zunanja stena	9	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	2,4	1,74	0,92	0,72	
1	vrata S	180	90	South	0,800	3,000	Sp - Zunanja stena	1	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	2,4	1,74	0,92	0,72	
1	vrata S	180	90	South	1,100	3,000	Sp - Zunanja stena	1	Steklo 0,5/0,6	4	Okno fix	2	0,50	0,60	1,24	0,09	0,09	0,11	0,09	1	1	1	1	0,040	0,010	3,3	2,58	0,86	0,78	





# Passive House Planning

## VENTILATION DATA

Building:

Treated Floor Area $A_{TFA}$	m <sup>2</sup>	<input type="text" value="919"/>	(Areas worksheet)
Room Height h	m	<input type="text" value="4,2"/>	(Annual Heat Demand worksheet)
Room Ventilation Volume ( $A_{TFA} \cdot h = V_V$ )	m <sup>3</sup>	<input type="text" value="3859"/>	(Annual Heat Demand worksheet)

### Ventilation System Design - Standard Operation

Occupancy	m <sup>2</sup> /P	<input type="text" value="8"/>
Number of Occupants	P	<input type="text" value="120,0"/>
Supply Air per Person	m <sup>3</sup> /(P*h)	<input type="text" value="20"/>
Supply Air Requirement	m <sup>3</sup> /h	<input type="text" value="2400"/>
Extract Air Rooms		
Quantity		
Extract Air Requirement per Room	m <sup>3</sup> /h	<input type="text" value="60"/>
Total Extract Air Requirement	m <sup>3</sup> /h	<input type="text" value="380"/>

Kitchen	Bathroom	Shower	WC	
<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="4"/>	<input type="text" value="10"/>	
<input type="text" value="60"/>	<input type="text" value="40"/>	<input type="text" value="20"/>	<input type="text" value="20"/>	
<input type="text" value="380"/>				

Design Air Flow Rate (Maximum)  m<sup>3</sup>/h

### Average Air Change Rate Calculation

Type of Operation	Daily Operation Duration h/d	Factors Referenced to Maximum	Air Flow Rate m <sup>3</sup> /h	Air Change Rate 1/h
Maximum	<input type="text" value="14,0"/>	<input type="text" value="1,00"/>	<input type="text" value="2400"/>	<input type="text" value="0,62"/>
Standard		<input type="text" value="0,77"/>	<input type="text" value="1846"/>	<input type="text" value="0,48"/>
Basic	<input type="text" value="10,0"/>	<input type="text" value="0,54"/>	<input type="text" value="1292"/>	<input type="text" value="0,33"/>
Minimum		<input type="text" value="0,40"/>	<input type="text" value="960"/>	<input type="text" value="0,25"/>
Residential Building		Average value	<input type="text" value="1938"/>	<input type="text" value="0,50"/>

### Infiltration Air Change Rate according to EN 13790

Wind Protection Coefficients According to EN 13790		
Coefficient e for Screening Class	Several Sides Exposed	One Side Exposed
No Screening	0,10	0,03
Moderate Screening	0,07	0,02
High Screening	0,04	0,01
Coefficient f	15	20

Wind Protection Coefficient, e		for Annual Demand: <input type="text" value="0,07"/>	for Heat Load: <input type="text" value="0,18"/>	
Wind Protection Coefficient, f		<input type="text" value="15"/>	<input type="text" value="15"/>	Net Air Volume for Press. Test $V_{n50}$
Air Change Rate at Press. Test $n_{50}$	1/h	<input type="text" value="0,60"/>	<input type="text" value="0,60"/>	<input type="text" value="3690"/> m <sup>3</sup>
				Air Permeability $q_{50}$ <input type="text" value="0,76"/> m <sup>3</sup> /(hm <sup>2</sup> )

### Type of Ventilation System

<input checked="" type="checkbox"/> Balanced PH Ventilation	Please Check	for Annual Demand:	for Heat Load:
<input type="checkbox"/> Pure Extract Air			
Excess Extract Air		1/h	<input type="text" value="0,00"/>
Infiltration Air Change Rate $n_{V,Res}$		1/h	<input type="text" value="0,04"/>
			<input type="text" value="0,100"/>

### Effective Heat Recovery Efficiency of the Ventilation System with Heat Recovery

<input checked="" type="checkbox"/> Central unit within the thermal envelope.	
<input type="checkbox"/> Central unit outside of the thermal envelope.	
Efficiency of Heat Recovery $\eta_{HR}$	<input type="text" value="0,90"/>
Transmittance Ambient Air Duct $\Psi$	W/(mK) <input type="text" value="1,064"/>
Length Ambient Air Duct	m <input type="text" value="4"/>
Transmittance Exhaust Air Duct $\Psi$	W/(mK) <input type="text" value="0,865"/>
Length Exhaust Air Duct	m <input type="text" value="4"/>
Temperature of Mechanical Services Room	°C <input type="text" value="20"/>
(Enter only if the central unit is outside of the thermal envelope.)	
	Av. Ambient Temp. Heating P. (°C) <input type="text" value="5,0"/>
	Av. Ground Temp (°C) <input type="text" value="11,9"/>

Effective Heat Recovery Efficiency  $\eta_{HR,eff}$

### Effective Heat Recovery Efficiency Subsoil Heat Exchanger

SHX Efficiency	$\eta^*_{SHX}$	<input type="text" value="0%"/>
Heat Recovery Efficiency SHX	$\eta_{SHX}$	<input type="text" value="0%"/>

### CERTIFIED HEAT RECOVERY UNITS

No.	Heat Recovery Unit	Heat Recovery Efficiency %	Electric Efficiency Wh/m <sup>3</sup>
1	Rekuperator	90%	0,35

# Passive House Planning

## SPECIFIC ANNUAL HEAT DEMAND

Climate: **Ljubljana 2014**  
 Building: **Vrtec ROGATEC**  
 Location: **ROGATEC**

Interior Temperature: **20,0** °C  
 Building Type/Use: **P+M**  
 Treated Floor Area A<sub>TFA</sub>: **918,7** m<sup>2</sup>

Building Element	Temperature Zone	Area m <sup>2</sup>	U-Value W/(m <sup>2</sup> K)	Temp. Factor f <sub>t</sub>	G <sub>t</sub> kWh/a	kWh/a	per m <sup>2</sup> Treated Floor Area
1. Exterior Wall - Ambient	A	847,8	0,115	1,00	73,7	7176	
2. Exterior Wall - Ground	B			0,42			
3. Roof/Ceiling - Ambient	A	877,8	0,104	1,00	73,7	6745	
4. Floor Slab	B	961,7	0,150	0,42	73,7	4466	
5.	A			1,00			
6.	A			1,00			
7.	X			0,75			
8. Windows	A	227,3	0,790	1,00	73,7	13223	
9. Exterior Door	A	9,9	1,000	1,00	73,7	729	
10. Exterior TB (length/m)	A			1,00			
11. Perimeter TB (length/m)	P	120,0	0,040	0,42	73,7	148	
12. Ground TB (length/m)	B			0,42			
Total of All Building Envelope Areas		2924,6					

**Transmission Heat Losses Q<sub>T</sub>** Total **32488** kWh/a **35,4** kWh/(m<sup>2</sup>a)

### Ventilation System:

Effective Heat Recovery Efficiency of Heat Recovery  $\eta_{eff}$  **89%**  
 Efficiency of Subsoil Heat Exchanger  $\eta_{SHX}$  **0%**

Effective Air Volume, V<sub>V</sub> **918,7** m<sup>2</sup> \* **4,20** m = **3858,5** m<sup>3</sup>

Energetically Effective Air Exchange n<sub>V</sub> **0,502** (1 - **0,89**) + **0,040** = **0,096** 1/h

### Ventilation Heat Losses Q<sub>V</sub>

**3859** m<sup>3</sup> \* **0,096** 1/h \* **0,33** W/(m<sup>2</sup>K) \* **73,7** kWh/a = **9002** kWh/a **9,8** kWh/(m<sup>2</sup>a)

### Total Heat Losses Q<sub>L</sub>

( **32488** + **9002** ) \* **1,0** = **41490** kWh/a **45,2** kWh/(m<sup>2</sup>a)

Orientation of the Area

Reduction Factor See Windows Sheet

g-Value (perp. radiation)

Area m<sup>2</sup>

Radiation HP kWh/(m<sup>2</sup>a)

kWh/a

1. North	0,66	0,50	61,74	108	2196
2. East	0,44	0,50	20,91	293	1337
3. South	0,52	0,50	105,07	431	11856
4. West	0,50	0,50	26,93	294	1960
5. Horizontal	0,54	0,50	12,66	435	1489

### Available Solar Heat Gains Q<sub>S</sub>

Total **18838** kWh/a **20,5** kWh/(m<sup>2</sup>a)

### Internal Heat Gains Q<sub>I</sub>

0,024 kh/d \* **205** W/m<sup>2</sup> \* **2,80** W/m<sup>2</sup> \* **918,7** m<sup>2</sup> = **12626** kWh/a **13,7** kWh/(m<sup>2</sup>a)

Free Heat Q<sub>F</sub>

Q<sub>S</sub> + Q<sub>I</sub> = **31464** kWh/a **34,2** kWh/(m<sup>2</sup>a)

Ratio of Free Heat to Losses

Q<sub>F</sub> / Q<sub>L</sub> = **0,76**

Utilisation Factor Heat Gains  $\eta_G$

(1 - (Q<sub>F</sub> / Q<sub>L</sub>)<sup>5</sup>) / (1 - (Q<sub>F</sub> / Q<sub>L</sub>)<sup>6</sup>) = **93%**

### Heat Gains Q<sub>G</sub>

$\eta_G$  \* Q<sub>F</sub> = **29109** kWh/a **31,7** kWh/(m<sup>2</sup>a)

### Annual Heat Demand Q<sub>H</sub>

Q<sub>L</sub> - Q<sub>G</sub> = **12381** kWh/a **13** kWh/(m<sup>2</sup>a)

Limiting Value **15** kWh/(m<sup>2</sup>a)

Requirement met? **Yes**

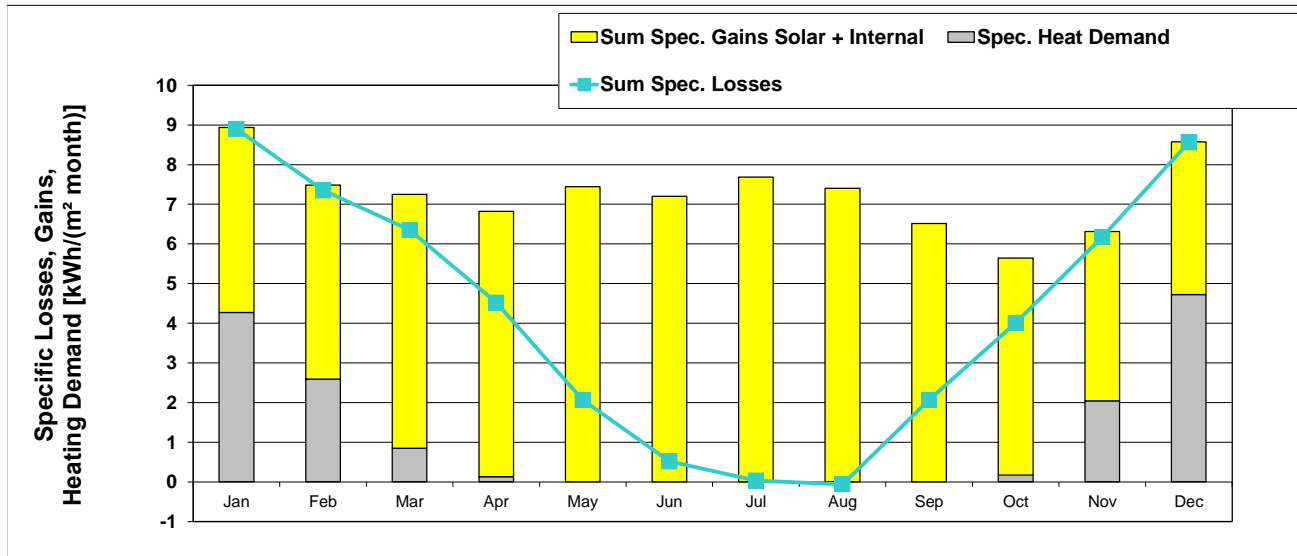
# PASSIVE HOUSE PLANNING

## SPECIFIC ANNUAL HEAT DEMAND MONTHLY METHOD

Climate: **Ljubljana 2014**  
 Building: **Vrtec ROGATEC**  
 Location: **ROGATEC**

Interior Temperature: **20** °C  
 Building Type/Use: **P+M**  
 Treated Floor Area A<sub>TFA</sub>: **919** m<sup>2</sup>

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - E	14,8	12,0	10,0	6,8	2,8	0,2	-0,5	-0,6	3,3	6,4	10,2	14,4	80	kKh
Heating Degree Hours - G	5,1	4,9	5,4	4,9	3,2	2,5	2,0	1,6	1,6	3,2	3,7	4,5	43	kKh
Losses - Exterior	7411	6021	5027	3424	1415	108	-261	-298	1658	3203	5117	7187	40011	kWh
Losses - Ground	765	735	808	728	483	367	291	243	240	480	555	677	6373	kWh
Sum Spec. Losses	8,9	7,4	6,4	4,5	2,1	0,5	0,0	-0,1	2,1	4,0	6,2	8,6	50,5	kWh/m <sup>2</sup>
Solar Gains - North	183	305	529	691	935	956	956	773	508	366	203	142	6548	kWh
Solar Gains - East	158	194	310	346	434	428	478	419	330	210	129	104	3538	kWh
Solar Gains - South	1678	1788	2365	2283	2393	2200	2448	2530	2420	1953	1403	1128	24588	kWh
Solar Gains - West	216	277	414	530	603	611	651	626	482	342	203	150	5106	kWh
Solar Gains - Horiz.	139	205	353	445	558	571	616	538	391	249	135	99	4298	kWh
Solar Gains - Opaque	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Internal Heat Gains	1914	1729	1914	1852	1914	1852	1914	1914	1852	1914	1852	1914	22534	kWh
Sum Spec. Gains Solar + Internal	4,7	4,9	6,4	6,7	7,4	7,2	7,7	7,4	6,5	5,5	4,3	3,8	72,5	kWh/m <sup>2</sup>
Utilisation Factor	99%	97%	86%	66%	28%	7%	0%	0%	32%	70%	97%	100%	49%	
Annual Heat Demand	3924	2381	778	120	0	0	0	0	1	154	1874	4341	13574	kWh
Spec. Heat Demand	<b>4,3</b>	<b>2,6</b>	<b>0,8</b>	<b>0,1</b>	<b>0,0</b>	<b>0,0</b>	<b>0,0</b>	<b>0,0</b>	<b>0,0</b>	<b>0,2</b>	<b>2,0</b>	<b>4,7</b>	<b>14,8</b>	kWh/m <sup>2</sup>



# Passive House Planning

## SPECIFIC SPACE HEATING LOAD

Building: **Vrtec ROGATEC**  
 Location: **ROGATEC**

Building Type/Use: **P+M**  
 Treated Floor Area  $A_{TFA}$ : **918,7** m<sup>2</sup> Interior Temperature: **20** °C  
 Climate (HL): **Ljubljana 2014**

Building Element	Temperature Zone	Area m <sup>2</sup>	Radiation: North East South West Horizontal					TempDiff 1 K	TempDiff 2 K	P <sub>T 1</sub> W	P <sub>T 2</sub> W
			Weather Condition 1: °C	Weather Condition 2: °C	Ground Design Temp. °C	U-Value W/(m <sup>2</sup> K)	Factor Always 1 (except "X")				
1. Exterior Wall - Ambient	A	847,8	-6,8	-5,9	12,7	0,115	1,00	26,8	25,9	2611	2523
2. Exterior Wall - Ground	B					1,00	7,3	7,3			
3. Roof/Ceiling - Ambient	A	877,8				0,104	1,00	26,8	25,9	2454	2371
4. Floor Slab	B	961,7				0,150	1,00	7,3	7,3	1058	1058
5.	A						1,00	26,8	25,9		
6.	A						1,00	26,8	25,9		
7.	X						0,75	26,8	25,9		
8. Windows	A	227,3				0,790	1,00	26,8	25,9	4810	4648
9. Exterior Door	A	9,9				1,000	1,00	26,8	25,9	265	256
10. Exterior TB (length/m)	A						1,00	26,8	25,9		
11. Perimeter TB (length/m)	P	120,0				0,040	1,00	7,3	7,3	35	35
12. Ground TB (length/m)	B						1,00	7,3	7,3		
13. House/DU Partition Wall	I	100,9				0,125	1,00	3,0	3,0	38	38

### Transmission Heat Losses P<sub>T</sub>

Total = **11271** or **10930**

### Ventilation System:

Effective Air Volume, V<sub>v</sub> =  $A_{TFA} \cdot \text{Clear Room Height}$  = **918,7** m<sup>2</sup> \* **4,20** m = **3859** m<sup>3</sup>

Efficiency of Heat Recovery of the Heat Exchanger  $\eta_{HR}$  = **89%** Heat Recovery Efficiency SHX = **0%** Efficiency SHX = **0%** or **0%**

Energetically Effective Air Exchange n<sub>v</sub> =  $n_{v,Res} + n_{v,system} \cdot (1 - \eta_{HR})$  = **0,100** + **0,502** \* (1 - **0,89**) = **0,156** or **0,156**

### Ventilation Heating Load P<sub>V</sub>

$V_L \cdot n_L \cdot C_{air} \cdot \text{TempDiff 1}$  or  $V_L \cdot n_L \cdot C_{air} \cdot \text{TempDiff 2}$  = **5330** or **5151**

### Total Heating Load P<sub>L</sub>

P<sub>T</sub> + P<sub>V</sub> = **16601** or **16082**

Orientation the Area	Area m <sup>2</sup>	g-Value (perp. radiation)	Reduction Factor (see Windows worksheet)	Radiation 1 W/m <sup>2</sup>	Radiation 2 W/m <sup>2</sup>	P <sub>S 1</sub> W	P <sub>S 2</sub> W
1. North	61,7	0,5	0,7	11	8	224	163
2. East	20,9	0,5	0,4	46	16	212	75
3. South	105,1	0,5	0,5	88	39	2420	1073
4. West	26,9	0,5	0,5	45	33	297	220
5. Horizontal	12,7	0,5	0,5	53	28	182	97

### Solar Heat Gain, P<sub>S</sub>

Total = **3335** or **1627**

### Internal Heat Gains P<sub>I</sub>

Spec. Power W/m<sup>2</sup> \* A<sub>TFA</sub> m<sup>2</sup> = **1,6** \* **919** = **1470** or **1470**

### Heat Gains P<sub>G</sub>

P<sub>S</sub> + P<sub>I</sub> = **4805** or **3097**  
 P<sub>L</sub> - P<sub>G</sub> = **11796** or **12984**

### Heating Load P<sub>H</sub>

= **12984** W

### Specific Heating Load P<sub>H</sub> / A<sub>TFA</sub>

= **14,1** W/m<sup>2</sup>

Input Max. Supply Air Temperature **52** °C  
 Max. Supply Air Temperature  $\vartheta_{Supply,Max}$  **52** °C  
 Supply Air Temperature Without Heating  $\vartheta_{Supply,Min}$  **17,0** °C or **17,1** °C

### For Comparison: Heating Load Transportable by Supply Air. P<sub>Supply Air,Max</sub>

= **22310** W specific: **24,3** W/m<sup>2</sup>

Supply Air Heating Sufficient? **Yes**

# Passive House Planning

## CLIMATE DATA

Standard/Regional Climate: Select here.

Regional Climate Data

Select Region Here

User Data

Select regional climate here:

Ljubljana 2014

Building:

Vrtec ROGATEC

Use Regional Data?

Yes

Climate Building

Ljubljana 2014

Chosen Method for Annual Heat Demand: Monthly Method

Monthly Data:

Ljubljana 2014

Annual Data:

No

Use Annual Climate Data Set

Results:

Annual Heat Demand

14,8 kWh/(m²a)

Heat Load

14,1 W/m²

Transfer to Annual Method

H<sub>T</sub>

205 d/a

G<sub>i</sub>

74 kWh/a

North

108 kWh/(m²a)

East

228 kWh/(m²a)

South

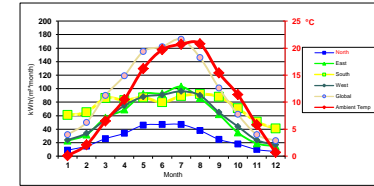
431 kWh/(m²a)

West

248 kWh/(m²a)

Horizontal

369 kWh/(m²a)



Parameters for PHPP Calculated Ground Temperatures:	Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating Load		Cooling Load
		Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2
	Ljubljana 2014	Latitude:	46,1	Longitude ° East	-14,7	Altitude m	385	Daily Temperature Swing Summer (K)				Radiation Data:	kWh/(m²·month)	Radiation: W/m²		W/m²
Phase Shift Months	Ambient Temp	0,1	2,1	6,5	10,5	16,2	19,7	20,7	20,8	15,4	11,4	5,8	0,7	-6,8	-5,9	25,9
2,00	North	9	15	26	34	46	47	47	38	25	18	10	7	11	8	47
Damping	East	23	32	57	69	92	93	103	86	62	35	19	15	29	9	114
-1,05	South	61	65	86	87	80	89	92	86	71	41	41	41	41	39	131
Depth m	West	24	34	54	75	88	91	96	90	65	44	24	17	32	29	124
3,32	Global	32	50	90	119	155	162	173	146	101	62	32	23	41	23	203
Shift of Average Temperature K	Dew Point	-2,8	-2,5	0,6	4,3	9,4	12,5	13,8	14,6	10,8	8,1	3,1	-1,7			
1,60	Sky Temp	-11,2	-10,4	-6,4	-1,9	4,0	8,2	9,2	9,9	5,4	2,6	-3,3	-9,4			17,0
	Ground Temp	13,1	12,7	12,7	13,2	15,6	16,6	17,4	17,8	17,8	15,7	14,8	13,9	12,7	12,7	17,8