Passivhaus 101
GAINS

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Heat Balance

GAINS:

A ‘free’ gain that can contribute to the heat balance is via the sun.

Heat Balance

GAINS:

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$$Qs = r * g * Aw * G$$

Qs=solar gains
r = Attenuating factor for glazing comprising the frame to window ratio, how shaded/dirty the glass is and factoring in any radiation that is non-perpendicular to the glass
g=Total solar transmittance value of the glass (typically a value in the region 0.55-0.6 ie 55-60% of the energy is getting through the glass (ie the amount of solar gain delivered)
Aw=Area of the glazing
G=Global solar irradiation (this depends on location and orientation of window)

Heat Balance

GAINS:

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$$Qs = r * g * Aw * G$$

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=391 KWh(m2a) ((South facing in Dublin))

Heat Balance

GAINS:

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$$Qs = 0.5 * 0.6 * 16m^2 * 391\ KWh(m2a)$$

$$Qs = 1876.8kWh/a$$

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=391 KWh(m2a) ((South facing in Dublin))

Heat Balance

GAINS:

This is for south facing walls – but what if we have them on the north?

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$$Qs = 0.5 * 0.6 * 16m^2 * 84\ KWh(m2a)$$

$$Qs =$$

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=84kWh(m2a) (North facing in Dublin))

Heat Balance

GAINS:

This is for south facing walls – but what if we have them on the north?

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$Qs = 0.5 * 0.6 * 16m^2 * 84$ KWh(m2a)

Qs = 403.2 kWh/a ie 4.65x less free energy

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=84kWh(m2a) (North facing in Dublin))

Heat Balance

GAINS:

This is for south facing walls – but what if we have them on the West?

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$Qs = 0.5 * 0.6 * 16m^2 * 239$ KWh(m2a)

Qs = kWh/a ie

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=84kWh(m2a) (North facing in Dublin))

Radiation North	119
Radiation East	231
Radiation South	391
Radiation West	239

Heat Balance

GAINS:

This is for south facing walls – but what if we have them on the East?

SOLAR GAINS:

Solar gains = Attenuating Factor For the glazing x Total solar energy Transmittance x Area of Window x Global Solar Radiation

$Qs = 0.5 * 0.6 * 16m^2 * 231\ KWh(m2a)$

Qs = kWh/a ie

Qs=solar gains
r = 0.5
g=0.6
Aw=say 16m2
G=84kWh(m2a) (North facing in Dublin))

Radiation North	119
Radiation East	231
Radiation South	391
Radiation West	239

Heat Balance

Climate data

Passive House with P

Detached house / Climate: Dublin / TFA: 271 m² / Heating: 15.3 kWh/(m²a) / Freq. overheating: 0 % / PER: 20.3 kWh/(m²a)

Selection of climate data

Country:	IE-Ireland
Region:	All
Climate data set:	IE0001a-Dublin
Climate zone:	3: Cool-temperate

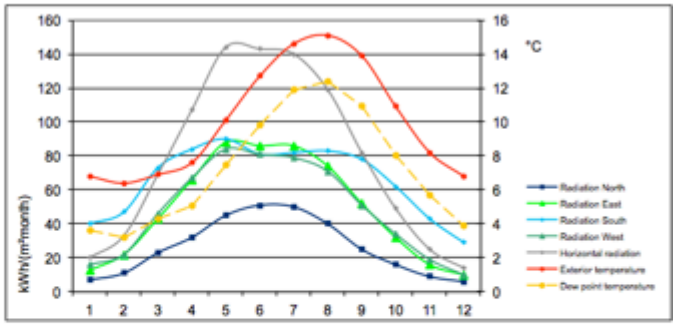
Altitude

Weather station:	10.0	m
Building location:	10	m

Result overview

Annual heating demand	15.3	kWh/(m²a)
Heating load	9.4	W/m²
Frequency of overheating	0.0	%
Sensible cooling	0.3	kWh/(m²a)
Latent cooling	0.0	kWh/(m²a)
Cooling load	-	W/m²
PER demand	20.3	kWh/(m²a)

	Data for heating Annual method	Data from monthly balance Heating	Cooling	
Heating / cooling period	218	243	78	d/a
Heating / cooling degree hours	66	77	-21	kKh/a
Radiation North	119	149	121	kWh/(m²a)
Radiation East	231	290	217	kWh/(m²a)
Radiation South	391	468	222	kWh/(m²a)
Radiation West	239	298	207	kWh/(m²a)
Horizontal radiation	366	461	356	kWh/(m²a)



Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating load		Cooling load		PER
Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2	Weather 1	Weather 2	factors
IE0001a-Dublin	Latitude °	53.3	Longitude °	-6.3	Altitude [m]	10	Daily temperature swing Summer [K]			7.1			Radiation: [W/m²]		Radiation: [W/m²]		
°C Exterior temperature	6.8	6.4	6.9	7.6	10.1	12.7	14.6	15.1	13.9	10.9	8.2	6.8	0.4	2.4	21.8	21.8	1.25
kWh/(m²month) Radiation North	7	11	23	32	45	51	50	40	25	16	9	6	15	5	86	86	1.25
kWh/(m²month) Radiation East	13	22	43	66	88	86	86	74	52	32	16	10	20	5	187	187	1.50
kWh/(m²month) Radiation South	40	47	73	84	90	81	82	83	78	62	43	29	30	10	204	204	1.00
kWh/(m²month) Radiation West	16	22	46	67	84	81	79	71	51	34	19	10	20	5	187	187	1.00
kWh/(m²month) Horizontal radiation	20	33	69	107	144	143	140	119	82	49	25	14	25	12	309	309	
°C Dew point temperature	3.6	3.2	4.3	5.1	7.5	9.8	11.9	12.4	10.9	8.0	5.7	3.9			15.4	15.4	
°C Sky temperature	-4.6	-5.1	-3.7	-2.7	0.4	3.2	5.7	6.3	4.5	1.0	-1.9	-4.2			12.4	15.4	
°C Ground temperature	10.9	10.1	9.8	10.0	10.7	11.9	12.9	13.6	13.5	13.3	12.7	11.8	9.8	9.8	13.9	13.9	
Comment:	Source: Meteonorm V8 & satellite data.																

Heat Balance

Areas determination

Passive House with PHPP Version 9.6a

Detached house / Climate: Dublin / TFA: 271 m² / Heating: 15.3 kWh/(m²a) / Freq. overheating: 0 % / PER: 20.3 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment
	Treated floor area	1	270.94	m²	Treated floor area according to PHPP manual
A	North windows	2	7.68	m²	
A	East windows	3	6.30	m²	Results come from the 'Windows' worksheet.
A	South windows	4	14.97	m²	Window areas are subtracted from individual opaque areas.
A	West windows	5	14.41	m²	which is displayed in the 'Windows' worksheet.
A	Horizontal windows	6	0.00	m²	
A	Exterior door	7	1.95	m²	Please subtract area of door from respective building assembly
A	External wall - Ambient	8	427.86	m²	Temperature zone "A" is ambient air
B	External wall - Ground	9	0.00	m²	Temperature zone "B" is the ground
A	Roof	10	280.00	m²	
B	Floor slab	11	258.00	m²	
		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"
X		14	0.00	m²	Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1): Factor for X
A	Thermal bridges Ambient	15	622.55	m	Units in m
P	Perimeter thermal bridges	16	0.00	m	Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)
B	Thermal bridges FS/BC	17	5.32	m	Units in m
I	Building element towards neighbor	18	0.00	m²	No heat losses, only considered for the heating load calculation
Total thermal envelope			1011.17	m²	

Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a] 6 Months	Radiation-load cooling period [kWh/a] 3 Months
North windows	0.915	268	265
East windows	0.868	472	437
South windows	0.813	2305	1130
West windows	0.765	1454	1147
Horizontal windows			
Exterior door	0.650		
External wall - Ambient	0.164	139	265
External wall - Ground			
Roof	0.136	150	461
Floor slab	0.100		
Thermal bridges - Overview	Ψ [W/(mK)]		
Thermal bridges Ambient	-0.018		
Perimeter thermal bridges			
Thermal bridges FS/BC	0.087		
Building element towards neighbour			
Average therm. envelope	0.158		

Go to building components list

Area input

2-Sorting: BY ID

Area no.	Building assembly description	To group No.	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User determined [m²]	-	User subtraction [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
					x (		x		+		-			)	=									
	Treated floor area	1	Treated floor area	1	x (		x		+	270.94	-			)	=	270.9								
	Exterior door	7	Exterior door	1	x (	0.93	x	2.10	+		-		) -		=	2.0	Exterior door	0.65						
1	External wall south	8	External wall - Ambient	1	x (		x		+	138.86	-		) -	15.0	=	123.9	01ud-External wall	0.164	180	90	South	0.90	0.60	0.90
2	External wall north	8	External wall - Ambient	1	x (		x		+	143.75	-		) -	7.7	=	136.1	01ud-External wall	0.164	0	90	North	0.90	0.60	0.90
3	External wall west	8	External wall - Ambient	1	x (		x		+	84.97	-		) -	14.4	=	70.6	01ud-External wall	0.164	270	90	West	0.90	0.60	0.90
4	Roof	10	Roof	1	x (		x		+	280.00	-		) -	0.0	=	280.0	02ud-Roof	0.136	0	14	Hor	1.00	0.90	0.90
5	Floor slab	11	Floor slab	1	x (		x		+	258.00	-		) -	0.0	=	258.0	03ud-Slab on grade	0.100	0	180	Hor			
6					x (		x		+		-		) -	0.0	=									
7	External wall east	8	External wall - Ambient	1	x (		x		+	103.64	-		) -	6.3	=	97.3	01ud-External wall	0.164	90	90	East	0.90	0.60	0.90
8					x (		x		+		-		) -	0.0	=									
9					x (		x		+		-		) -	0.0	=									

Heat Balance

Now repeat for your project···

Remember we're only focussing on heat balance rather than heat load

Radiation North	119
Radiation East	231
Radiation South	391
Radiation West	239