

03.02\_PH- SUMMER SCHOOL

# PH-Calculation - PHPP

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03.02.02 Working with PHPP: Areas and Volume

03.02.03 Working with PHPP: Envelope, U-Values

03.02.04 Working with PHPP: Windows

03.02.05

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## The PHPP calculation software Description

PHPP means Passive House Planning (Design) Package.

The PHPP calculation software calculates energy demand for buildings. It is compatible with international norms (ISO 13790) and well validated with dynamic simulation tools as well as with measured data. It is especially adapted to high-performance buildings and can be used to prove Passive House requirements. The planning package comprises many tools specifically useful for the design of high-performance buildings.



Source: [http://apps1.eere.energy.gov/buildings/tools\\_directory/software.cfm/ID=549/pagename=alpha\\_list](http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=549/pagename=alpha_list)

## The PHPP calculation software Description

The Passive House Planning (Design) Package (PHPP) includes:

- energy calculations (incl. R or U-values)
- design of window specifications
- design of the indoor air quality ventilation system
- sizing of the heating load
- sizing of the cooling load
- forecasting for summer comfort
- sizing of the heating and domestic hot water (DHW) systems
- calculations of auxiliary electricity, primary energy requirements:
  - (circulation pumps, etc.), as well as projection of CO<sub>2</sub> emissions
  - verifying calculation proofs of KfW and EnEV (Europe)
  - Climate Data Sheet: Climate regions may be selected from over 200 locations in Europe and North America. User-defined data can also be used.
  - lot of tools useful in the design of passive houses, e.g. a calculation
  - tool to determine internal heat loads, data tables for primary energy factors
  - a comprehensive handbook, not only introducing PHPP use, but also highlights crucial topics to be considered in Passive House design.

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## The PHPP calculation software

### Description

#### Keywords

energy balance, high-performance houses, passive houses

#### Validation/Testing

Basis for energy balance: ISO 13790. Tested with dynamic building simulation and with measured data in field project with some 1,000 apartments and additionally with non-residential buildings.

#### Expertise Required

Experience in building design or building energy consulting. PHPP training is recommended but not prerequisite. Use of manual (included).

#### Users

1,0000 users worldwide: 500 in the United States

#### Audience

Architects, engineers, energy consultants, scientists.

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## The PHPP calculation software

### Description

#### **Programming Language**

Spreadsheet

#### **Input**

Data are entered as numbers or chosen in menus.

Needed:

- surface areas of thermal envelope,
- length of thermal bridges (optional),
- thermal characteristics of materials (thermal conductance) or building components (U-values),
- and of thermal bridges (optional);
- characteristics of ventilation system,
- efficiency of heat recovery,
- location of building.

Characteristics of certified passive house building components are implemented.

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## The PHPP calculation software

### Description

#### Output

Pre-formatted documentations:

- Overview,
- energy balance,
- heating load,
- cooling load,
- summer comfort (percentage of overheating),
- ventilation,
- energy use/losses for heating system,
- primary energy demand.

#### Computer Platform

Windows PC with MS Office

#### Strengths

Energy design and thermal comfort for high performance buildings, esp. passive houses

## The PHPP calculation software

### Description

#### **Weaknesses**

Multizonal dynamic building simulation for buildings with large glazing areas (solar gains) and/or high need of control

#### **Actually available languages**

German, English, French, Italian, Dutch, Polish, Russian, Ceska, Slovensko, Magyar, (Albanian)

#### **Contact**

Company: Passive House Institute

Address: Rheinstr. 44-46, 64283 Darmstadt Germany

E-mail: [mail@passiv.de](mailto:mail@passiv.de)

Website: [http://www.passivhaustagung.de/Passive\\_House\\_E/PHPP.html](http://www.passivhaustagung.de/Passive_House_E/PHPP.html)

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# The PHPP calculation software Description

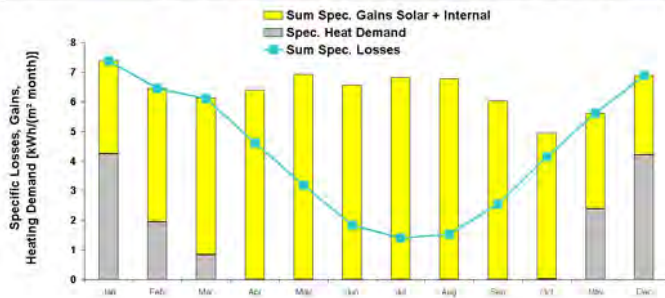
Some of the sheets with results

## PASSIVE HOUSE PLANNING SPECIFIC ANNUAL HEAT DEMAND MONTHLY METHOD

Climate	Standard	Germany	Building Temperature	PH	°C
Building	End-of-Terrace Passive House Kranichstein	Standard	Building Type/Use	Terraced House/Dwelling	
Location	Darmstadt Kranichstein	Standard	Treated Floor Area	156	m²
Street					
Postcode/City	D-64289 Darmstadt				
Country	Germany/Hesse				
Building Type	Terraced House/Dwelling				
Home Owner(s) / Client(s)	Bauherrngemeinschaft Passivhaus				
Street					
Postcode/City	D-64289 Darmstadt				
Architect	Prof. Bott/Idder/Westermeyer				
Street	Jahnstr. 8				
Postcode/City	D-64285 Darmstadt				
Mechanical System	0ob Dipl.-Ing. Norbert Starz				
Street	Bahnhostr. 49				
Postcode/City	D-64319 Pfungstadt				
Year of Construction	1991				
Number of Dwelling Units	1	Interior Temperature	20.0	°C	
Enclosed Volume V <sub>i</sub>	665.0 m³	Internal Heat Gains	2.3	W/m²	
Number of Occupants	4.5				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heating Degree Hours - External	15.1	12.1	12.1	8.9	5.7	3.0	2.1	3.5	4.7	5.2	11.4	14.1	101
Heating Degree Hours - Ground	7.4	7.0	7.6	6.8	5.3	4.7	4.7	3.9	4.5	5.2	5.8	6.8	70
Unheated - External	1039	852	817	599	357	205	143	170	217	557	773	955	6624
Unheated - Ground	132	124	135	122	112	83	75	69	80	92	103	121	1249
Sum Spec. Losses	7.4	6.5	6.6	4.6	3.2	1.8	1.4	1.5	2.5	4.2	6.6	6.8	51.8
Solar Gains - North	25	36	66	94	127	140	140	112	75	46	25	15	908
Solar Gains - East	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar Gains - South	195	307	444	558	572	511	509	579	538	424	215	141	5112
Solar Gains - West	0	11	16	26	33	33	29	22	14	6	4	4	236
Solar Gains - Horiz	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar Gains - Opaque	19	36	54	33	105	104	107	94	69	43	21	13	746
Internal Heat Gains	244	220	244	239	244	236	244	244	236	244	236	244	2010
Sum Spec. Gains Solar + Internal	3.1	4.0	5.9	6.4	6.9	6.9	6.9	6.0	4.9	3.7	3.7	4.9	49.9
Absolut Factor	100%	100%	100%	7.2%	46%	29%	20%	23%	42%	34%	100%	100%	60%
Annual Heat Demand	663	304	131	0	0	0	0	0	2	372	656	2127	
Spec. Heat Demand	4.3	2.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.2	13.6	



## Passive House Verification



PHPP

Building	End-of-Terrace Passive House Kranichstein
Location and Climate	Darmstadt Kranichstein Standard Germany
Street	
Postcode/City	D-64289 Darmstadt
Country	Germany/Hesse
Building Type	Terraced House/Dwelling
Home Owner(s) / Client(s)	Bauherrngemeinschaft Passivhaus
Street	
Postcode/City	D-64289 Darmstadt
Architect	Prof. Bott/Idder/Westermeyer
Street	Jahnstr. 8
Postcode/City	D-64285 Darmstadt
Mechanical System	0ob Dipl.-Ing. Norbert Starz
Street	Bahnhostr. 49
Postcode/City	D-64319 Pfungstadt
Year of Construction	1991
Number of Dwelling Units	1
Enclosed Volume V <sub>i</sub>	665.0 m³
Number of Occupants	4.5
Interior Temperature	20.0 °C
Internal Heat Gains	2.3 W/m²

Specific Demands with Reference to the Treated Floor Area			
Treated Floor Area:		156.0 m²	
Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	14 kWh/(m²·a)	15 kWh/(m²·a)	Yes
Pressurization Test Result:	0.2 h⁻¹	0.6 h⁻¹	Yes
Specific Primary Energy Demand (BHW, Heating, Cooling, Auxiliary and Household Electricity):	65 kWh/(m²·a)	120 kWh/(m²·a)	Yes
Specific Primary Energy Demand (BHW, Heating and Auxiliary Electricity):	37 kWh/(m²·a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	kWh/(m²·a)		
Heating Load:	10 W/m²		
Frequency of Overheating:	3 %	over 25 °C	
Specific Useful Cooling Energy Demand:	kWh/(m²·a)	15 kWh/(m²·a)	
Cooling Load:	9 W/m²		

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: \_\_\_\_\_ signed: \_\_\_\_\_

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## Working with PHPP Manual

The manual for PHPP is available  
in German and English.

This presentation is focused on the  
most important points. For all the  
details, please use the manual.



Fachinformation PHI-2007/1

### Passivhaus Projektierungs Paket 2007

# PHPP 2007

Anforderungen an  
qualitätsgeprüfte Passivhäuser

Source:

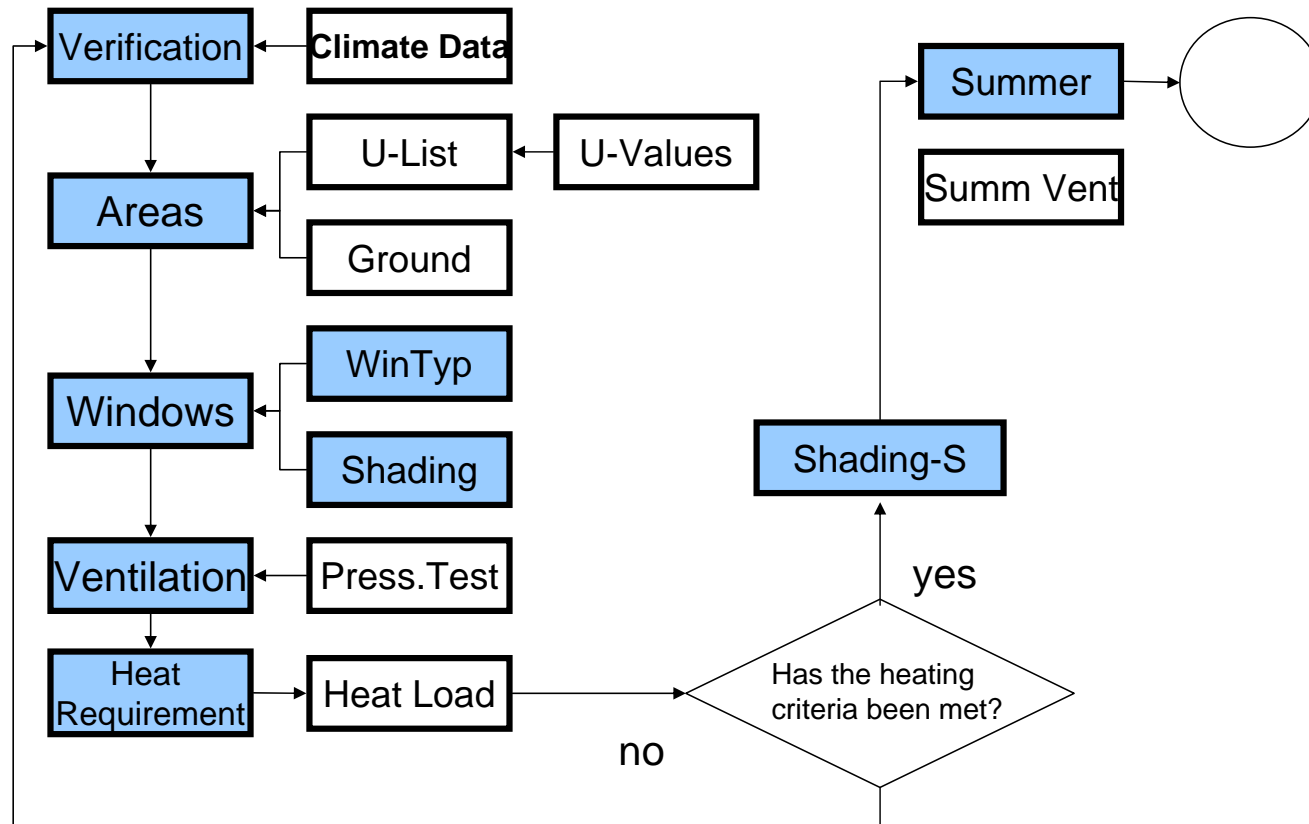
## Working with PHPP

### Inputs to PHPP

- Start> F0 Verification (Climate Data, Occupants)
- F0-F1 Calculate the U-values
- F1-F2 Input of the areas (Note: use external dimensions for walls)
- F2-F3 Sheet WinTyp and Windows. Pay attention to the orientation  
Enter the windows individually if they have different shading.  
Enter a separate line for fixed glazing, take glazed outside-doors as windows
- F3-F4 Input the shading variables for each window
- F4-F5 Ventilation sheet
- F5-F6 Input thermal bridges, prioritise the psi-value of the windows
- F6-F7 Input summer cooling system and summer shading

Source:

# Working with PHPP Inputs to PHPP



Source:

# Working with PHPP Inputs to PHPP - Excel sheet verification

passive house Freundorfer	
Oberbayern	Garmisch-P.
Martin Greif Straße 20	
83080 Oberaudorf	
bavaria	
one family residence	
Josefa und Franz Freundorfer	
Martin Greif Straße 20	
83080 Oberaudorf	
Dipl. Ing. Elke Kneißl	
Morellstraße 27	
86159 Augsburg	
B.Tec Dr. Harald Krause	
Sonnenfeld 9	
83122 Samerberg	

no standard climate

2006
1
742,0 m <sup>3</sup>
5,0

Interior Temperature: 20,0 °C  
Internal Heat Sources: 2,1 W/m<sup>2</sup>

### Internal Heat Sources

Building Type: Residence

Standard Values used? Standard

### Planned Number of Occupants:

5 Planning

Source:

# Working with PHPP Inputs to PHPP - Choose the climate region

## Passive House Planning

### CLIMATE DATA

Standard/Regional Climate: Select Here.

Regional Climate Data ▼

Germany (DIN 4108-6) ▼

Choose the regional climate here:

Garmisch-P. ▼

#### Climate Data for Heat Load

Heat Load Data Already Assigned ▼

No Choice/Heat Load Data Assigned ▼

Use Regional Data? **Yes**  
 Climate Building **Garmisch-P.**  
 Chosen Method **Annual Method**  
 Heat Requirement:  
 Monthly Data: Garmisch-P. (Region  
 Annual Data: 0  
 Use Annual Climate Data Set **No**

#### Annual Climate Data

**Carried over into Annual Method**

H <sub>T</sub>	261
G <sub>t</sub>	107
East	428
South	693
West	416
North	227
Horizontal	635

Source:

## Working with PHPP

### Inputs to PHPP - Areas and volume

#### Calculation of the TFA (treated floor area)

- The calculation rule was simplified in some points and was adapted to the demands of the energy balancing. Heated secondary rooms are included within this operation.
- For calculating the TFA at first the thermal envelope has to be defined. It is shaped by the external surfaces of the insulated external components. The thermal envelope includes all heated rooms. At the same time it marks the balance limit for the energy balance. The TFA consists of all areas inside the thermal envelope.
- The TFA of an apartment or house is the sum of the TFAs all the living rooms inside the apartment. Living rooms are defined as rooms inside an apartment that either are situated aboveground or that offer a window area of at least 10% as measured by the base area. Stairs with more than three steps, landings and elevators are not added to the living room.

Source:

## Working with PHPP

### Inputs to PHPP - Areas and volume

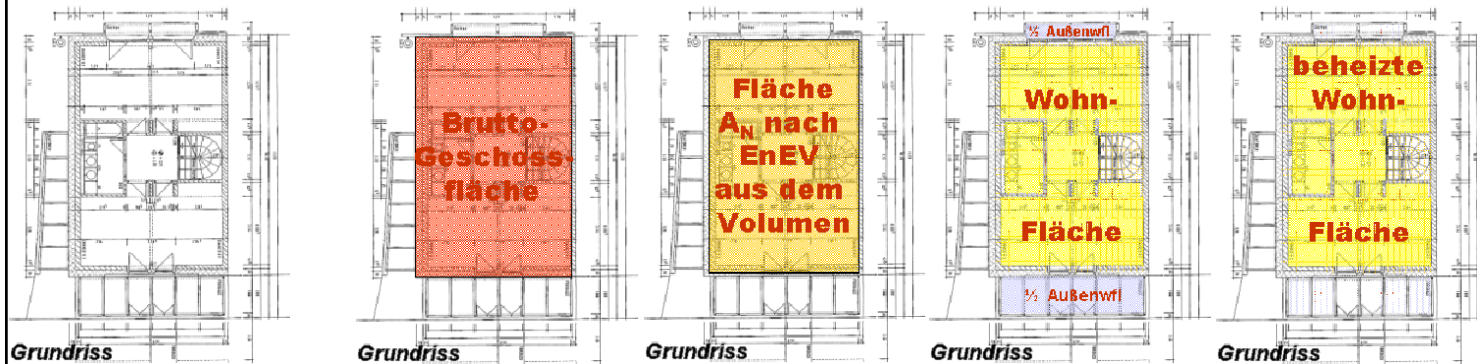
#### Calculation of the TFA (treated floor area)

- Basement and engineering room etc. inside the thermal envelope, that are no living rooms, are taken into account by 60%.
- Calculating the base area:
  - 4.1 The base area of a room is identified by dimension of the shell. Plaster etc. is not to be abstracted.
  - 4.2 The dimensions of the shell are the inside widths between the walls without regarding any wall arrangements, baseboards, ovens, radiators etc.
- Chimneys, columns etc. measuring less than 0,1 m<sup>2</sup> of base area are not abstracted from the energy reference area
- Door- and window recesses are not regarded
- Bevels:
  - 7.1 Areas of the room with a clear height of at least 2 meters are calculated completely.
  - 7.2 Areas of the room with a clear height of at least 1 meter and less than 2 meters are calculated on half.

Source:

## Working with PHPP Inputs to PHPP - Areas and volume

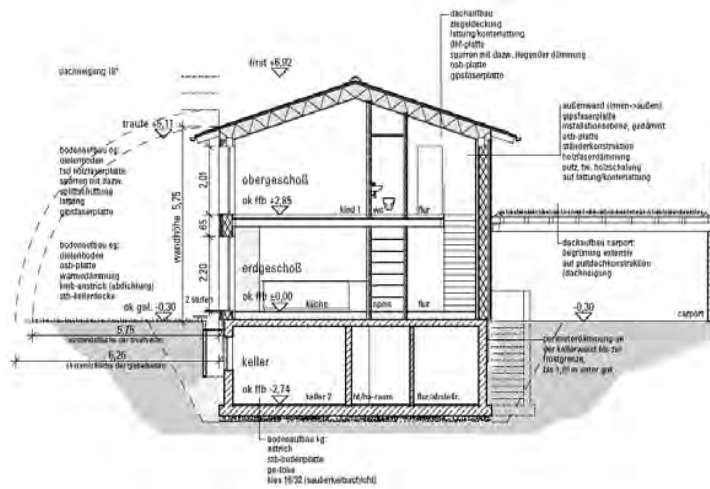
**Other methods for the calculation of the floor area with other results !!!**



Gross floor area	212 m <sup>2</sup>
Area A <sub>N</sub> of the EnEV	207 m <sup>2</sup>
Living area. incl. external surfaces	183 m <sup>2</sup>
Heated living area	156 m <sup>2</sup>
<hr/>	
TFA - Treated floor area	157 m <sup>2</sup>

Source:

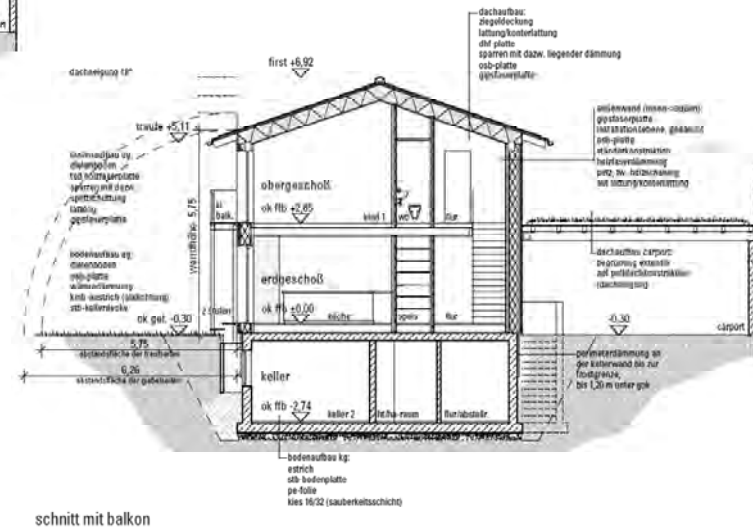
# Working with PHPP Inputs to PHPP - Areas and volume (House F.)



Heights of the wall L+R 5.94m  
ridge 7.11m mean value 6.53m

Timber wall up to 2.75m

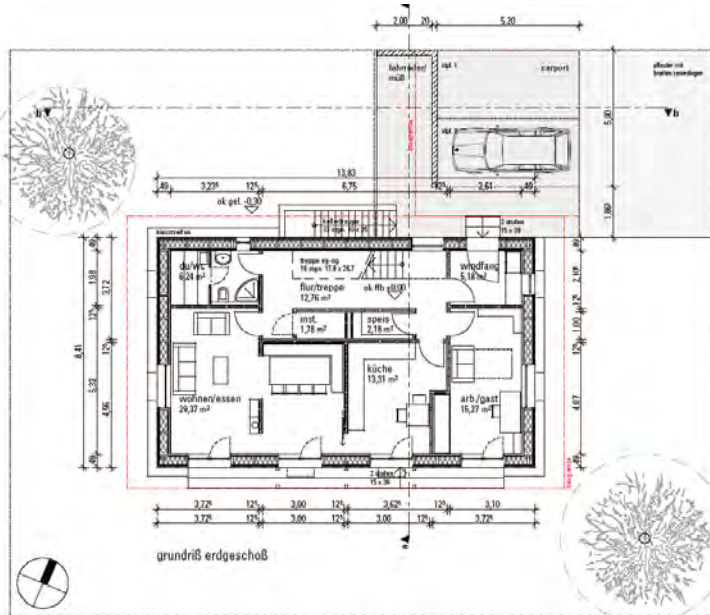
Roof width L + R 4.43m



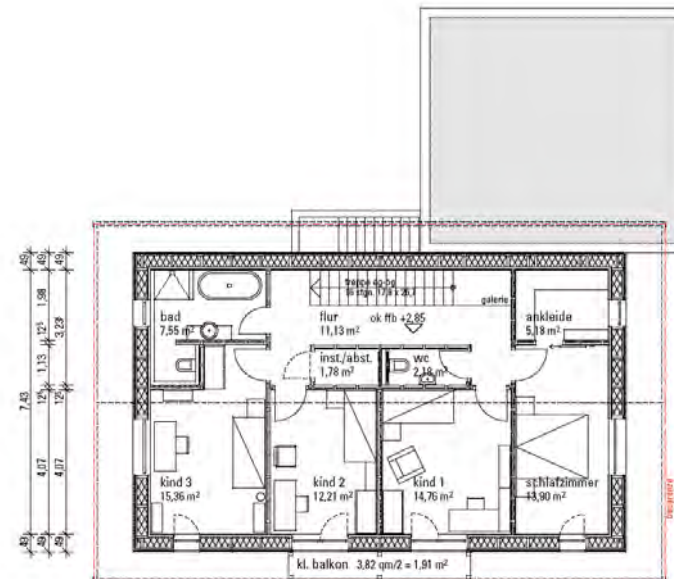
schnitt mit balkon

Source:

# Working with PHPP Inputs to PHPP - Areas and volume (House F.)



Foot point 13.83m x 8.41m  
Treated Floor Area 165,23 m<sup>2</sup>



U-value wall = 0.11 W/m<sup>2</sup>K,  
Ceiling and roof = 0.10 W/m<sup>2</sup>K

Source:

## Working with PHPP Inputs to PHPP - Areas and volume (House F.)

### Facade east



ostansicht

Fixed window first floor 1x 0.75x2.25  
1x 1.50x 2.25  
Normal window top floor 1x 0.75x 1.45  
1x 1.50 x1.45

Normal window top floor 1x 0.75 x1.45  
1x 1.50 x1.45

Fixed window first floor 1x 1.50 x2.25

### Facade west



Source:

# Working with PHPP Inputs to PHPP - Areas and volume (House F.)



Facade south

French door 2x 0.925x 2.25  
6x 1.85 x 2.25

$U_g$ -value = 0.60 W/m<sup>2</sup>K

g-value = 52%

$U_D$ -value = 0.65 W/m<sup>2</sup>K

Outdoor I 1.13 x2.20  
Tilt window 0.925 x2.25  
Outdoor II 1.13 x 2.20

Facade east



Source:

## Working with PHPP Inputs to PHPP - Areas and volume (House F.)

Area Nr.	Building Element Description	Group Nr.	Assigned to Group	Quantity	x (	a [m]	x	b [m]	+	User-Determined [m²]
	Treated Floor Area	1	Treated Floor Area	1	x (		x		+	165,23
	East Windows	2	East Windows	<b>Please complete in Windows v</b>						
	South Windows	3	South Windows							
	West Windows	4	West Windows							
	North Windows	5	North Windows							
	Horizontal Windows	6	Horizontal Windows							
	Exterior Door	7	Exterior Door							
1	wall east 1.floor	8	Exterior Wall - Ambient Air	1	x (	8,41	x	2,75	+	
2	wall west 1.floor	8	Exterior Wall - Ambient Air	1	x (	8,41	x	2,75	+	
3	wall south 1.floor	8	Exterior Wall - Ambient Air	1	x (	13,830	x	2,750	+	
4	wall north 1.floor	8	Exterior Wall - Ambient Air	1	x (	13,830	x	2,750	+	
5	ceiling basement	9	Exterior Wall - Ground	1	x (	13,830	x	8,410	+	
6	roof	10	Roof/Ceiling - Exterior Air	2	x (	13,830	x	4,430	+	
7	wall east 2.floor	8	Exterior Wall - Ambient Air	1	x (	8,41	x	3,78	+	
8	wall west 2.floor	8	Exterior Wall - Ambient Air	1	x (	8,41	x	3,78	+	
9	wall south 2.floor	8	Exterior Wall - Ambient Air	1	x (	13,830	x	3,190	+	
10	wall north 2.floor	8	Exterior Wall - Ambient Air	1	x (	13,830	x	3,190	+	
11					x (		x		+	

Choose Group Nr. from sheet area A 14 till 17

Source:

# Working with PHPP

## Inputs to PHPP - Calculation of U-Values (House F.)

**1** wall plastered

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>: **0,04**

Area of Section 1	λ [W/(mK)]	Area of Section 2 (optional)	λ [W/(mK)]	Area of Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1. plaster board	0,800					12
2. fiber board	0,040	lightwood	0,130			60
3. OSB board	0,170					15
4. cellulose	0,040			timber frame	0,130	340
5.						
6. fiber board inthermo	0,050					60
7. outside plaster	0,600					5
8.						
		Percentage of Sec. 2		Percentage of Sec. 3		Total
		<b>7,0%</b>		<b>17,0%</b>		<b>49,2</b> cm

U-Value: **0,107** W/(m<sup>2</sup>K)

Source:

# Working with PHPP Inputs to PHPP - Calculation of U-Values (House F.)

## Excel sheet U- list

## Passive House Planr U - LIST

Sheet with compilation of calculated assemblies from U-Values worksheet and further assemblies from data banks

Type							
Asse mbl Nr.	Assembly Description	Total Thickness	U-Value	Thickness of Insulation Layer	Thermal Conductivity of Insulation Layer	Spec. Capacity $C_{eff}$	Min. Moisture Diffusion
		m	W/(m <sup>2</sup> K)	m	W/(mK)	kJ/m <sup>2</sup> /K	sd <sub>min</sub> m
1	- none -						
2	wall plastered	0,492	0,11				
3	wall timber	0,462	0,11				
4	ceiling to the basement	0,544	0,10				
5	roof	0,491	0,10				
6							
7							
8							
9							

Source:

# Working with PHPP Inputs to PHPP - Areas and volume (House F.)

## Connect the areas with the U-Values

User-Determined [m²]	-	User Deduction [m²]	-	Deducted Window Areas [m²]	) =	Area [m²]
165,23	-				) =	165,2

subtract the outdoors



	-	5,00	) -		=	-5,0
	-		) -	0,0	=	0,0
	-		) -	0,0	=	0,0
	-		) -	0,0	=	41,1
	-		) -	0,0	=	41,1
	-		) -	0,0	=	116,3
	-		) -	0,0	=	122,5
	-		) -	0,0	=	0,0
	-		) -	0,0	=	0,0
	-		) -	0,0	=	41,1
	-		) -	0,0	=	41,1

Selection of the corresponding building elements	Nr.
--	-----

Values from Windows worksheet  
Values from Windows worksheet  
Values from Windows worksheet  
Values from Windows worksheet  
Values from Windows worksheet

outdoor	▼	6
wall plastered	▼	2
wall plastered	▼	2
wall plastered	▼	2
wall plastered	▼	2
ceiling to the basement	▼	4
roof	▼	5
wall timber	▼	3
wall plastered	▼	2
wall timber	▼	3
wall timber	▼	3

Source:

## Working with PHPP Inputs to PHPP – Input of thermal bridges (House F.)

### Thermal bridges entries in “Areas”

Nr. of Thermal Bridge	Thermal Bridge Description	Group Nr.	Assigned to Group	Quantity
1	Edge outside wall	15	Exterior Air Thermal Bridges	4
2	Outside wall-roof	15	Exterior Air Thermal Bridges	1
3	Outside wall basement	16	Perimeter Thermal Bridges	1
4	Top of the roofs	15	Exterior Air Thermal Bridges	1
5	inside wall roof	15	Exterior Air Thermal Bridges	1
6	inside wall outside wall	15	Exterior Air Thermal Bridges	1

Source:

# Working with PHPP

## Inputs to PHPP - Calculation of $U_g$ and $g$ -Values (House F.)

### Excel sheet WinTyp

To the frames from row: 64

	Type			
Assembly Nr.	Glazing	g-Value	$U_g$ -Value	
			W/(m <sup>2</sup> K)	
1	Triple glass Unitop	0,520	0,600	
2				
3				

Source:

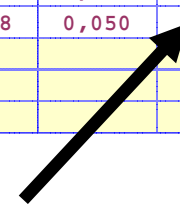
# Working with PHPP Inputs to PHPP - Calculation of $U_g$ and g-Values (House F.)

## Excel sheet WinTyp

### FRAME TYPE IN ACCORDANCE WITH

To the glazings from row: 2

Type	$U_w$ -Value	Frame Measurements				Thermal Bridge	Thermal Bridge
Frame	Frame	Width - Left	Width - Right	Width - Below	Width - Above	$\Psi_{\text{glass edge}}$	$\Psi_{\text{Installation}}$
	W/(m <sup>2</sup> K)	m	m	m	m	W/(mK)	W/(mK)
Double wood normal	0,950	0,118	0,118	0,118	0,118	0,050	0,014
Double wood fixed	0,950	0,068	0,068	0,068	0,068	0,050	0,014



this value comes out of a finite element calculation and not out of the telephone

Source:

## Working with PHPP

### Inputs to PHPP - Areas and types of windows (House F.)

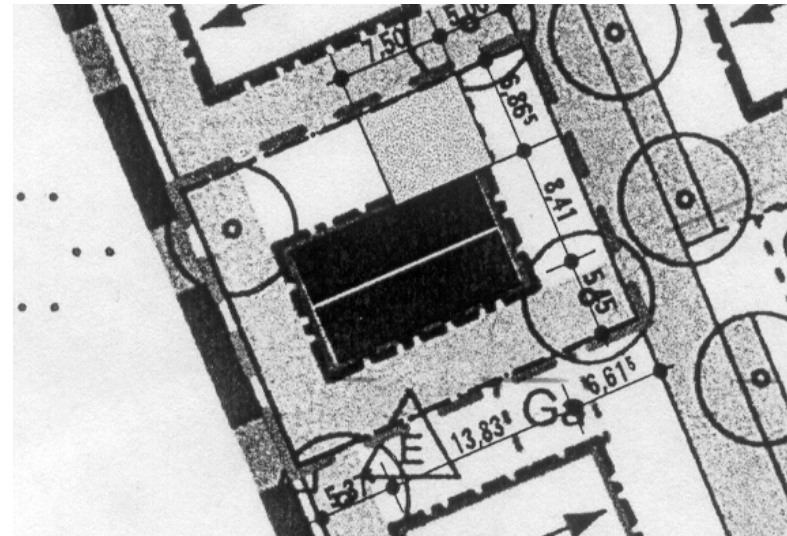
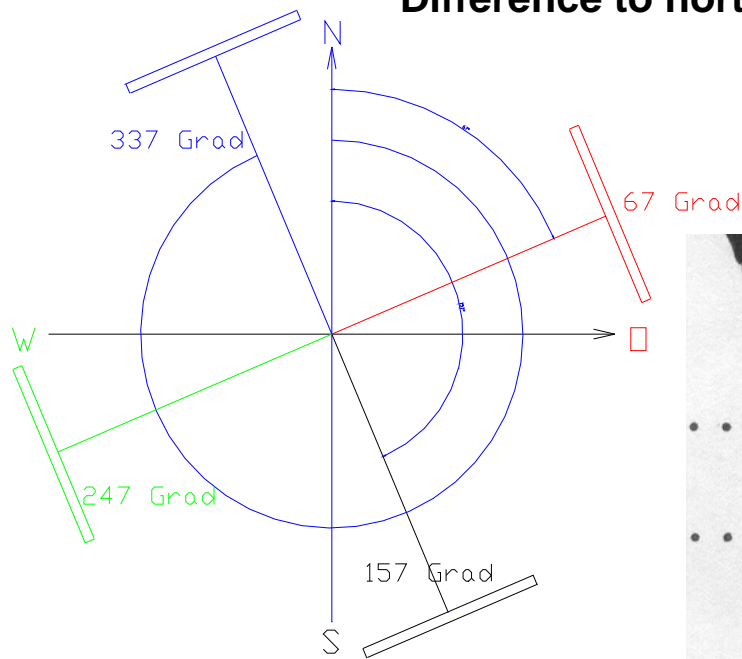
#### Excel sheet Window

Quantity	Description	Deviation from North	Angle of Inclination Against Horizontal	Orientation	Window Rough Openings		Installed		Glazing		Window Frame
					Width	Height	in Area in the Areas worksheet	Nr.	Select glazing from the WinTyp worksheet	Nr.	Select window from the WinTyp worksheet
					m	m	Select:		Select:		Select:
1	tilt stair 1	337	90	North	0,925	2,250	wall north 1.floor	4	Triple glass Unit	1	Double wood nor
								0		0	
1	sleeping 2.f	67	90	East	1,500	1,450	wall east 2.floor	7	Triple glass Unit	1	Double wood nor
1	clothing 2.f	67	90	East	0,750	1,450	wall east 2.floor	7	Triple glass Unit	1	Double wood nor
1	fixed office	67	90	East	1,500	2,250	wall east 1.floor	1	Triple glass Unit	1	Double wood fixe
1	fixed entrance	67	90	East	0,750	2,250	wall east 1.floor	1	Triple glass Unit	1	Double wood fixe
2	door sep.2.f	157	90	South	0,925	2,250	wall south 2.floor	9	Triple glass Unit	1	Double wood nor
2	door to fixe	157	90	South	0,925	2,250	wall south 2.floor	9	Triple glass Unit	1	Double wood nor
2	fixed 2.floc	157	90	South	0,925	2,250	wall south 2.floor	9	Triple glass Unit	1	Double wood fixe
2	door middle	157	90	South	0,925	2,250	wall south 1.floor	3	Triple glass Unit	1	Double wood nor
2	fixed middle	157	90	South	0,925	2,250	wall south 1.floor	3	Triple glass Unit	1	Double wood fixe
2	door l+r 1.f	157	90	South	0,925	2,250	wall south 1.floor	3	Triple glass Unit	1	Double wood nor
2	fixed l+r 1.f	157	90	South	0,925	2,250	wall south 1.floor	3	Triple glass Unit	1	Double wood fixe
1	living fixed	247	90	West	1,500	2,250	wall west 1.floor	2	Triple glass Unit	1	Double wood fixe
1	children 2.f	247	90	West	1,500	1,450	wall west 2.floor	8	Triple glass Unit	1	Double wood nor
1	bathroom 2.f	247	90	West	0,750	1,450	wall east 2.floor	7	Triple glass Unit	1	Double wood nor

Source:

# Working with PHPP Inputs to PHPP - Orientation of windows (House F.)

## Difference to northern orientation



Source:

## Working with PHPP Inputs to PHPP - Shading of windows



Source:

## Working with PHPP Inputs to PHPP - Shading of windows

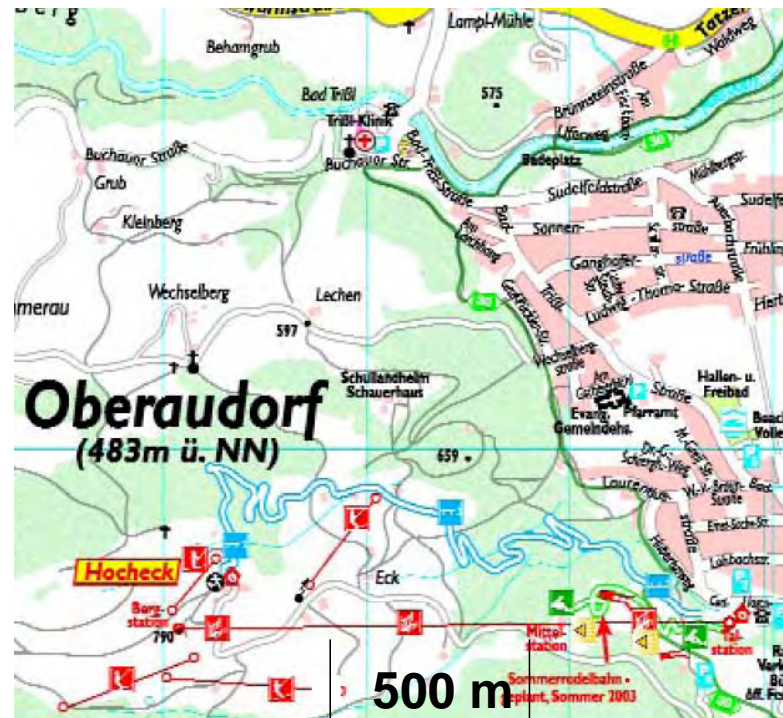
We are looking out of every window and add the values to the PHPP in three cases

- Trees, houses, mountains .....
- Reveal
- Overhang: roof, balcony...

Source:

# Working with PHPP Inputs to PHPP - Shading of windows

## Plan of surrounding area for the shading of mountains



Source:

# Working with PHPP Inputs to PHPP - Shading of windows (House F.)

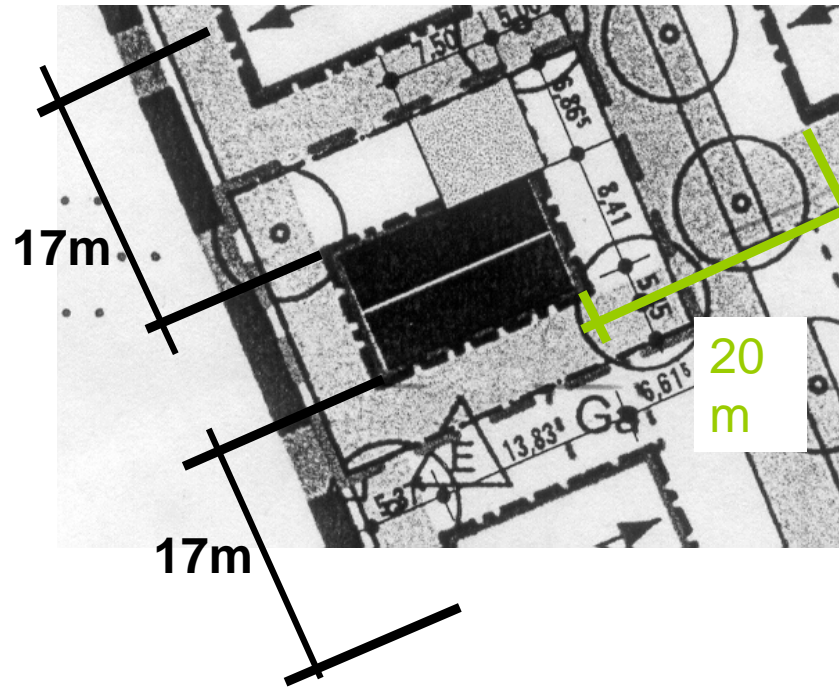
## The input of the mountains

Height of the Shading Object	Horizontal Distance	Window Reveal Depth	Distance from Glazing Edge to Reveal	Overhang Depth	Distance from Upper Glazing Edge to Overhang	Additional Shading Reduction Factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor
m	m	m	m	m	m	%	%	%
$h_{Hori}$	$a_{Hori}$	$o_{Reveal}$	$d_{Reveal}$	$o_{over}$	$d_{over}$	$r_{ot}$	$r_H$	$r_R$
7,00	17,00	0,10	0,00	0,10	0,00	100%	72%	86%
0,00	0,00	0,10	0,05	0,80	1,40	100%	100%	95%
3,25	20,00	0,10	0,05	0,80	1,20	100%	87%	84%
0,00	0,00	0,10	0,00	0,10	0,00	100%	100%	95%
7,00	20,00	0,10	0,00	0,10	0,00	100%	74%	84%
4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
4,25	17,00	0,00	0,00	0,80	0,25	100%	87%	100%
7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
175,00	500,00	0,10	0,00	0,10	0,00	100%	76%	96%
175,00	500,00	0,10	0,05	0,80	1,40	100%	76%	96%
175,00	500,00	0,10	0,05	0,80	1,20	100%	76%	88%

Source:

# Working with PHPP Inputs to PHPP - Shading of windows (House F.)

**Position plan is needed for the input of the shading**



Source:

# Working with PHPP

## Inputs to PHPP - Shading of windows (House F.)

### The input of the neighbour houses

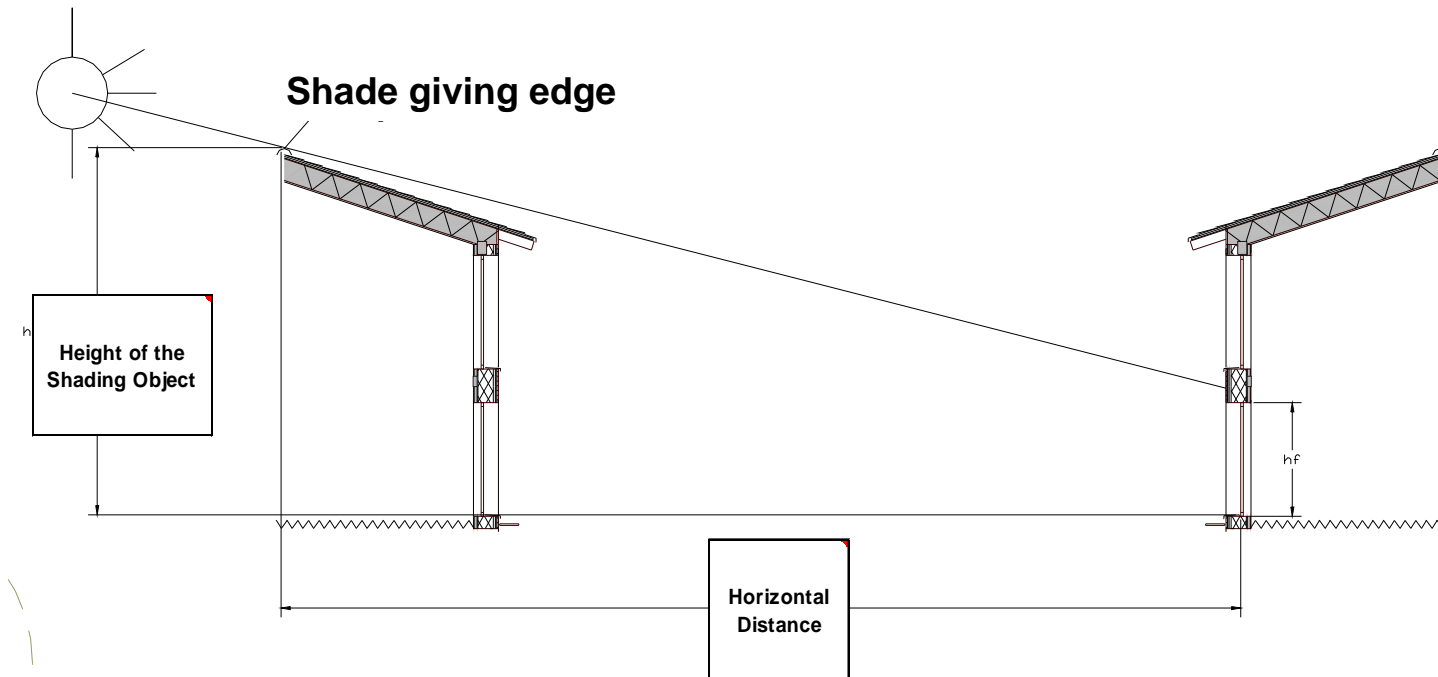
	Height of the Shading Object	Horizontal Distance	Window Reveal Depth	Distance from Glazing Edge to Reveal	Overhang Depth	Distance from Upper Glazing Edge to Overhang	Additional Shading Reduction Factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor
	m	m	m	m	m	m	%	%	%
	$h_{Hori}$	$a_{Hori}$	$O_{Reveal}$	$d_{Reveal}$	$O_{over}$	$d_{over}$	$r_{ot}$	$r_H$	$r_R$
North	7,00	17,00	0,10	0,00	0,10	0,00	100%	72%	86%
East	0,00	0,00	0,10	0,05	0,80	1,40	100%	100%	95%
East	3,25	20,00	0,10	0,05	0,80	1,20	100%	87%	84%
East	0,00	0,00	0,10	0,00	0,10	0,00	100%	100%	95%
East	7,00	20,00	0,10	0,00	0,10	0,00	100%	74%	84%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South	4,25	17,00	0,00	0,00	0,80	0,25	100%	87%	100%
South	7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
South	7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
West	175,00	500,00	0,10	0,00	0,10	0,00	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,40	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,20	100%	76%	88%

Source:

# Working with PHPP

## Inputs to PHPP - Shading of windows

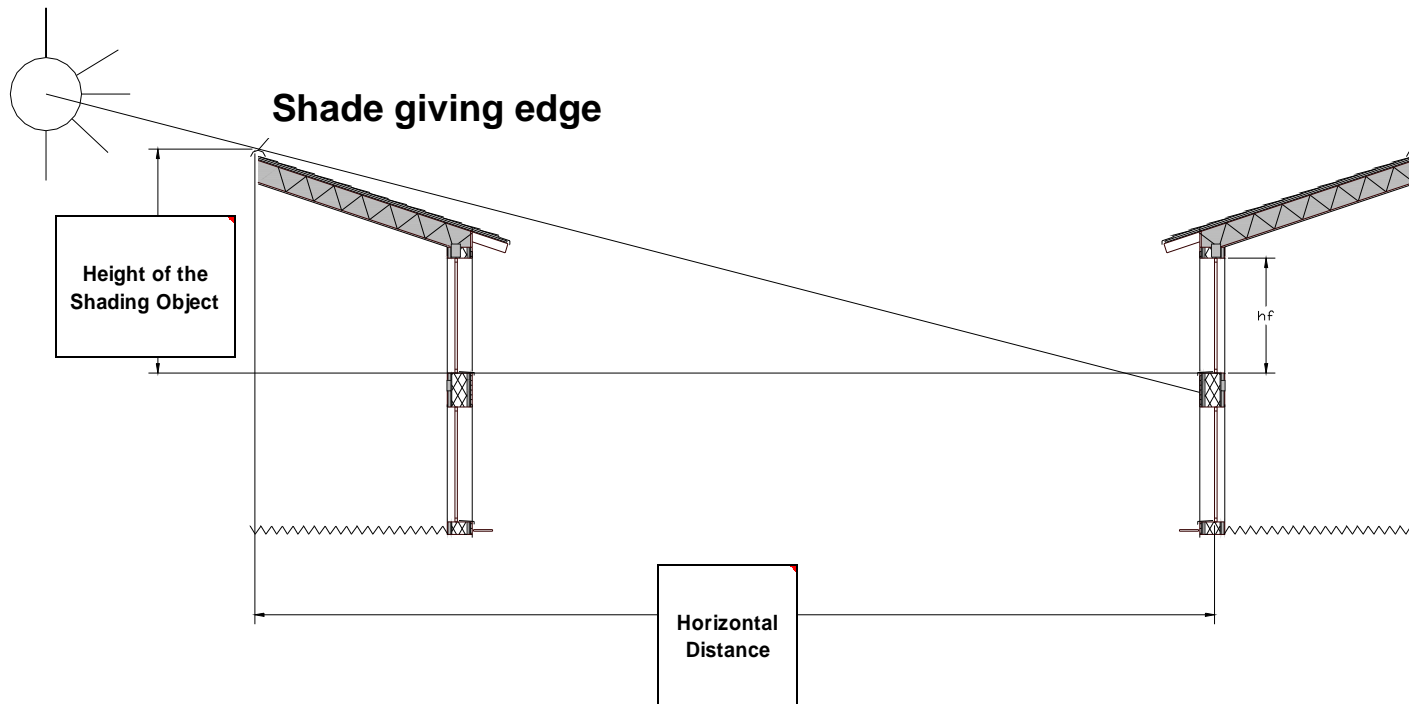
### Shading of a house by a window on the first floor



Source:

# Working with PHPP Inputs to PHPP - Shading of windows

## Shading of a house by a window on the second floor



Source:

# Working with PHPP Inputs to PHPP - Shading of windows (House F.)

## The input of the window reveal

	Height of the Shading Object	Horizontal Distance	Window Reveal Depth	Distance from Glazing Edge to Reveal	Overhang Depth	Distance from Upper Glazing Edge to Overhang	Additional Shading Reduction Factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor
	m	m	m	m	m	m	%	%	%
	$h_{Hori}$	$a_{Hori}$	$o_{Reveal}$	$d_{Reveal}$	$o_{over}$	$d_{over}$	$r_{ot}$	$r_H$	$r_R$
North	7,00	17,00	0,10	0,00	0,10	0,00	100%	72%	86%
East	0,00	0,00	0,10	0,05	0,80	1,40	100%	100%	95%
East	3,25	20,00	0,10	0,05	0,80	1,20	100%	87%	84%
East	0,00	0,00	0,10	0,00	0,10	0,00	100%	100%	95%
East	7,00	20,00	0,10	0,00	0,10	0,00	100%	74%	84%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South	4,25	17,00	0,00	0,00	0,80	0,25	100%	87%	100%
South	7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
South	7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
West	175,00	500,00	0,10	0,00	0,10	0,00	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,40	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,20	100%	76%	88%

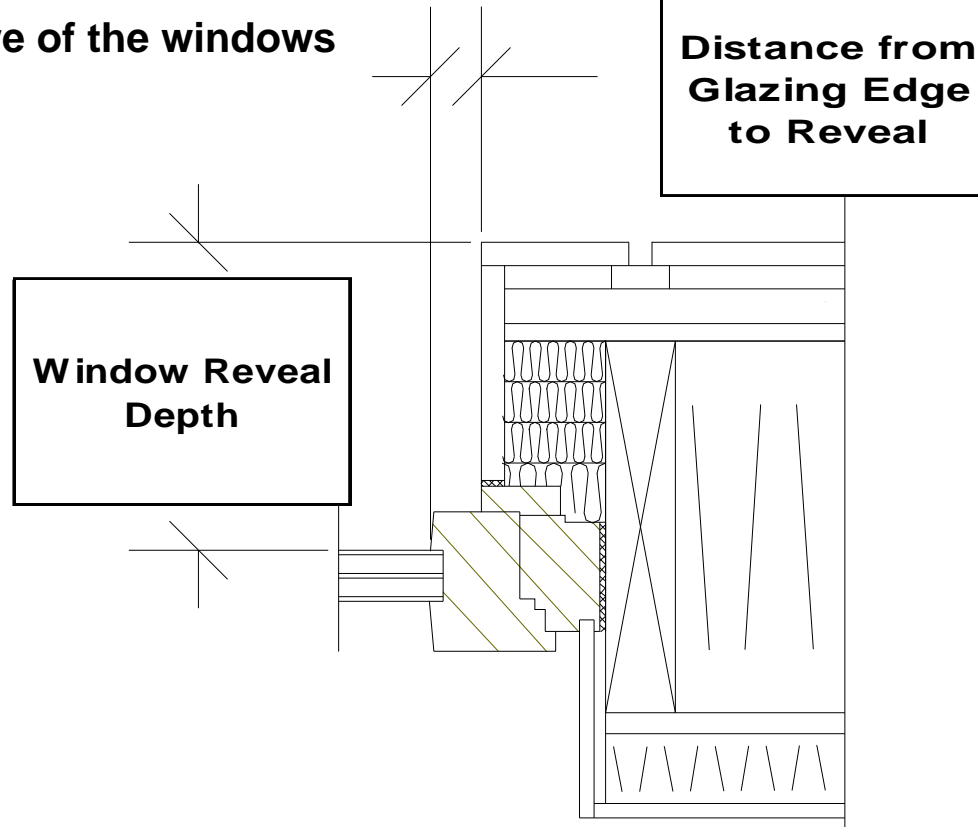
Source:

## Working with PHPP Inputs to PHPP - Shading of windows

**Embrasure of the windows**

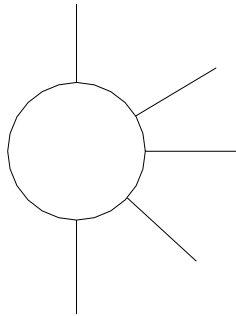
**Distance from  
Glazing Edge  
to Reveal**

**Window Reveal  
Depth**

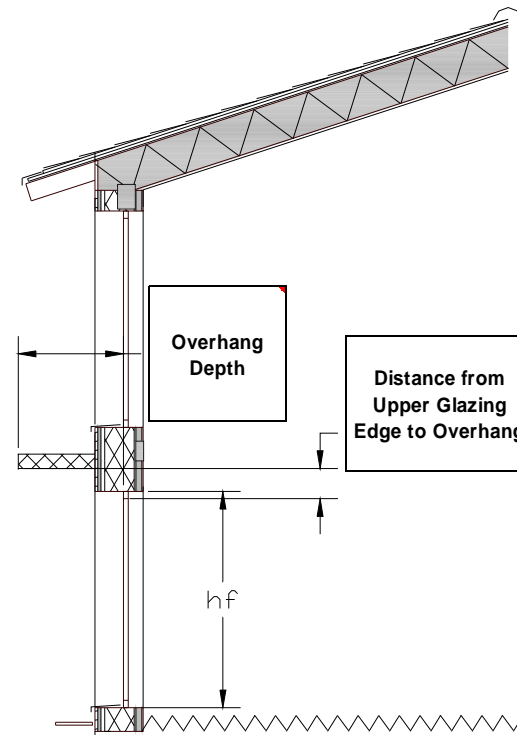


Source:

# Working with PHPP Inputs to PHPP - Shading of windows



## Shading of a supernatant: roof, balcony...



Source:

# Working with PHPP

## Inputs to PHPP - Shading of windows (House F.)

### The input of the overhangs

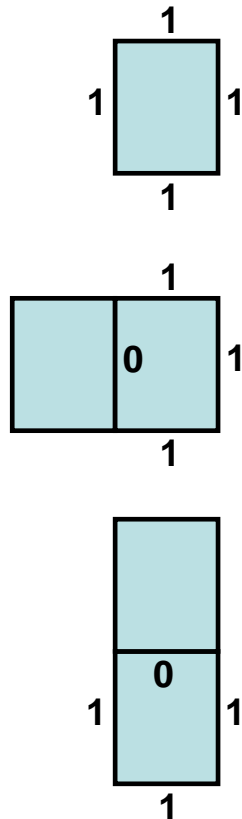
	Height of the Shading Object	Horizontal Distance	Window Reveal Depth	Distance from Glazing Edge to Reveal	Overhang Depth	Distance from Upper Glazing Edge to Overhang	Additional Shading Reduction Factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor
	m	m	m	m	m	m	%	%	%
	$h_{Hori}$	$a_{Hori}$	$o_{Reveal}$	$d_{Reveal}$	$o_{over}$	$d_{over}$	$r_{ot}$	$r_H$	$r_R$
North	7,00	17,00	0,10	0,00	0,10	0,00	100%	72%	86%
East	0,00	0,00	0,10	0,05	0,80	1,40	100%	100%	95%
East	3,25	20,00	0,10	0,05	0,80	1,20	100%	87%	84%
East	0,00	0,00	0,10	0,00	0,10	0,00	100%	100%	95%
East	7,00	20,00	0,10	0,00	0,10	0,00	100%	74%	84%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South	4,25	17,00	0,10	0,05	0,80	0,25	100%	87%	94%
South								%	100%
South								%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
South	7,00	17,00	0,10	0,05	0,80	0,25	100%	72%	94%
South	7,00	17,00	0,00	0,00	0,80	0,25	100%	72%	100%
West	175,00	500,00	0,10	0,00	0,10	0,00	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,40	100%	76%	96%
West	175,00	500,00	0,10	0,05	0,80	1,20	100%	76%	88%

If there is no overhang put in the „reveal on the top!

Source:

# Working with PHPP Inputs to PHPP - Installation of windows (House F.)

## Window: installation and result



Installation				Ψ-Value		Results			
Left 1/0	Right 1/0	Para-pet 1/0	Lintel 1/0	Ψ <sub>Spacer</sub>	Ψ <sub>Installation</sub>	Window Area	Glazing Area	U-Value Window	Glass Per Window
				W/(mK)	W/(mK)	m <sup>2</sup>	m <sup>2</sup>	W/(m <sup>2</sup> K)	%
1	1	1	1	0,05	0,01	2,1	1,39	0,89	0,67
				#NV	#NV				
1	1	1	1	0,05	0,01	2,2	1,53	0,85	0,71
1	1	1	1	0,05	0,01	1,1	0,62	0,96	0,57
1	1	1	1	0,05	0,01	3,4	2,88	0,79	0,85
1	1	1	1	0,05	0,01	1,7	1,30	0,89	0,77
1	1	1	1	0,05	0,01	4,2	2,78	0,89	0,67
1	0	1	1	0,05	0,01	4,2	2,78	0,87	0,67
0	1	1	1	0,05	0,01	4,2	3,34	0,84	0,80
1	0	1	1	0,05	0,01	4,2	2,78	0,87	0,67
0	1	1	1	0,05	0,01	4,2	3,34	0,84	0,80
1	0	1	1	0,05	0,01	4,2	2,78	0,87	0,67
0	1	1	1	0,05	0,01	4,2	3,34	0,84	0,80
1	1	1	1	0,05	0,01	3,4	2,88	0,79	0,85
1	1	1	1	0,05	0,01	2,2	1,53	0,85	0,71
1	1	1	1	0,05	0,01	1,1	0,62	0,96	0,57

Source:

# Working with PHPP Inputs to PHPP – Results of windows (House F.)

## Solar heat gain with average shading

g-Value	Reduction Factor for Solar Radiation	Window Areas	Window U-Values	Glazing Area	Average Global Radiation
		m <sup>2</sup>	W/(m <sup>2</sup> K)	m <sup>2</sup>	kWh/(m <sup>2</sup> a)
0,52	0,46	8,33	0,85	6,3	337
0,52	0,44	29,14	0,86	21,1	669
0,52	0,46	6,64	0,84	5,0	519
0,52	0,40	2,08	0,89	1,4	240
0,00	0,00	0,00	0,00	0,0	635
<b>0,52</b>	<b>0,44</b>	<b>46,18</b>	<b>0,86</b>	<b>33,9</b>	

107,2	
<b>Transmission Losses</b>	<b>Heat Gains Solar Radiation</b>
kWh/a	kWh/a
757	672
2686	4447
596	824
198	105
0	0
<b>4237</b>	<b>6048</b>

Source:

# Working with PHPP

## Inputs to PHPP – Input of ventilation (House F.)

Building:

Treated Floor Area  $A_{TFA}$   m<sup>2</sup> (Areas worksheet)  
 Room Height, h  m (Annual Heat Requirement worksheet)  
 Room Ventilation Volume ( $A_{TFA} \cdot h$ ) =  $V_{RAX}$   m<sup>3</sup> (Annual Heat Requirement worksheet)

### Ventilation System Layout - Standard Operation

Occupancy	m <sup>2</sup> /P	<input type="text" value="33"/>				
Number of Occupants	P	<input type="text" value="5,0"/>				
Supply Air per Person	m <sup>3</sup> /(P*h)	<input type="text" value="30"/>				
Supply Air Requirement	m <sup>3</sup> /h	<input type="text" value="150"/>				
Extract Air Rooms		Kitchen	Bathroom	Shower	WC	thing, wasch
Quantity		<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>
Extract Air Requirement per Room	m <sup>3</sup> /h	60	40	20	20	<input type="text" value="25"/>
Total Extract Air Requirement	m <sup>3</sup> /h	<input type="text" value="165"/>				

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

### Average Air Change Rate Calculation

Type of Operation	Daily Operation Times h/d	Factors Referenced to Maximum	Air Flow Rate m <sup>3</sup> /h	Air Change Rate 1/h
Maximum	<input type="text" value="0,0"/>	<input type="text" value="1,00"/>	<input type="text" value="165"/>	<input type="text" value="0,40"/>
<b>Standard</b>	<input type="text" value="24,0"/>	<input type="text" value="0,77"/>	<input type="text" value="127"/>	<input type="text" value="0,31"/>
Basic	<input type="text" value="0,0"/>	<input type="text" value="0,54"/>	<input type="text" value="89"/>	<input type="text" value="0,22"/>
Minimum	<input type="text" value=""/>	<input type="text" value="0,40"/>	<input type="text" value="66"/>	<input type="text" value="0,16"/>
<input checked="" type="checkbox"/> Residential Building	<b>Average Value</b>	<input type="text" value="0,77"/>	<b>Average Airflow Volume (m<sup>3</sup>/h)</b> <input type="text" value="127"/>	<b>Average Air Change Rate</b> <input type="text" value="0,31"/>

Source:

# Working with PHPP

## Inputs to PHPP – Input of ventilation (House F.)

Infiltration Air Change Rate Following DIN EN 832.

Wind Protection Coefficients, e and f, in Accordance With EN 832.		
Coefficient e for Screening Class	Several Sides Exposed	One Side Exposed
	No screening	0,10
Moderate Screening	0,07	0,02
High Screening	0,04	0,01
Coefficient f	15	20

	for Ann. Reqment:	for Heat Load:	
Wind Protection Coefficient, e	0,07	0,18	
Wind Protection Coefficient, f	15	15	Net Air Volume for Press. Test
Air change rate at Press. Test $n_{50}$	1/h	0,40	413

### Type of Ventilation System

<input checked="" type="checkbox"/>	Balanced PH Ventilation	Please check.	for Ann. Reqment:	for Heat Load:
<input type="checkbox"/>	Pure Extract Air			
<input type="checkbox"/>	Excess Extract Air			
	Infiltration Air Change Rate $n_{V,Res}$		1/h	0,00
			1/h	0,028
			1/h	0,070

### Actual efficiency of the ventilation system with heat recovery

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

Efficiency of Heat Recovery $\eta_{eff,HR}$			92%	
Conductance Supply Air Duct $\Psi$	W/(mK)		0,337	Calculation see Secondary Calculati
Supply Air Duct Length	m		2	
Conductance Extract Air Duct $\Psi$	W/(mK)		0,337	Calculation see Secondary Calculati
Extract Air Duct Length	m		2	Room Temperatur
Temperature of Mechanical Service Room	°C		12	Average Exterior 1
(Enter only if the central unit is outside of the thermal envelope.)				

Actual Efficiency of Heat Recovery  $\eta_{HR,eff}$  **91%**

Efficiency of Heat Recovery of Subsoil Heat Exchanger  $\eta_{SHX}$  20%

### Secondary Calculation:

#### $\Psi$ -Value Supply or Outdoor Air Duct

Nominal Width	160	mm
Insul. Thickness:	60	mm
Reflecting surface? Please mark with an "x"!		
Yes		
No	<input checked="" type="checkbox"/>	
Thermal Conductivity	0,035	W/(mK)
Nominal Air Flow Rate	1,27	m³/h
$\Delta\theta$	8	K
Interior Duct Diameter	0,160	m
Exterior Duct Diameter	0,160	m
Exterior Diameter	0,280	m
$\alpha$ -Interior	8,71	W/(m²K)
$\alpha$ -Surface Area	5,77	W/(m²K)
<b><math>\Psi</math>-Value</b>	<b>0,337</b>	<b>W/(mK)</b>
Surface temperature difference	1,145	K

Source:

# Working with PHPP Inputs to PHPP – Summer ventilation (House F.)

Exterior Heat Flow Coefficient,  $H_{T,e}$

68,4 W/K

Ground Heat Flow Coefficient,  $H_{T,g}$

10,6 W/K

Efficiency of Heat Recovery of the plate heat exchanger

$\eta_{HR}$  91%

effective Air Volume  $V_V$

$A_{TFA}$  m<sup>2</sup>  
165,2

Room Clearance m  
2,50

= 413 m<sup>3</sup>

Mark with 'x':

- 
- 
- 
- 

Free Ventilation (Windows + Cracks):

Summer Air Change Rate: 1/h 0,40

Mech. Exhaust Only 0,40 1/h

Supply and Exhaust Air as During Winter Operation, With HR.

Supply/Exh. w/o HR 0,20

$\eta_{SHX}$  Subsoil Heat Excha 1/h

$\eta_{HR}$  0,000

$n_{V,Rest}$  1/h 0,028

Energetically Effective Air Exchange  $n_V$

0,000 + 0,400 \* (1 - 0,000) + 0,028

Ext. Vent. Heat Flow Coeff.,  $H_{V,e}$

$V_V$  m<sup>3</sup>  
413

$n_{V,equi}$  Portion 1/h  
0,228

$C_{Air}$  Wh/(m<sup>3</sup>K)  
0,33

= 31,1 W/K

Ground Vent. Heat Flow Coeff.,  $H_{V,g}$

413

0,250

0,33

= 27,3 W/K

$Q_T$  W/K

$Q_L$  W/K

kWh/a

Can come from nature or mechanical Ventilation (without heat recovery)

Source:

# Working with PHPP

## Inputs to PHPP – Summer shading (House F.)

	Summer		Summer				
	Upper Glazing Edge to Overhang	Shading Reduction Factor (Summer)	Shading Reduction Factor, z	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang Shading Reduction Factor	Total Summer Shading Reduction Factor
	m	%	%	%	%	%	%
	$d_{over}$			$r_H$	$r_L$	$r_o$	$r_v$
North	0,00	100%	100%	78%	83%	98%	63%
East	1,40	100%	100%	100%	96%	93%	89%
East	1,20	100%	100%	93%	90%	92%	77%
East	0,00	100%	30%	100%	96%	99%	29%
East	0,00	100%	100%	82%	90%	99%	73%
South	0,25	50%	100%	92%	89%	66%	27%
South	0,25	50%	100%	92%	89%	66%	27%
South	0,25	50%	100%	92%	100%	67%	31%
South	0,25	50%	100%	87%	89%	66%	25%
South	0,25	50%	100%	87%	100%	67%	29%
South	0,25	50%	100%	87%	89%	66%	25%
South	0,25	50%	100%	87%	100%	67%	29%
West	0,00						
West	1,40						
West	1,20						

Overhang as natural shading, cheap and sure

East and west windows are typical overheating elements. Put in the z value of the used shading system.

Source:

# Working with PHPP Inputs to PHPP – Summer shading (House F.)

Interior Heat Sources  $Q_i$

\*  =

Frequency of Overheating  $h_{g \geq g_{max}}$   at an overheating limit of  $\vartheta_{max} = 25^\circ\text{C}$

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

## SUMMER

Climate:	<input type="text" value="Garmisch-P."/>	Interior Temperature:	<input type="text" value="20"/> °C
Building:	<input type="text" value="passive house Freundorfer"/>	Building Type/Use:	<input type="text" value="one family house"/>
Location:	<input type="text" value="Oberbayern"/>	Treated Floor Area $A_{TFA}$ :	<input type="text" value="165,2"/> m <sup>2</sup>
Specific Capacity:	<input type="text" value="84"/> Wh/K per m <sup>2</sup> FS	Standard Occupancy:	<input type="text" value="5,0"/> Pers
Overheating Limit:	<input type="text" value="25"/> °C		

Building Element	Temperature Zone	Area m <sup>2</sup>	U-Value W/(m <sup>2</sup> K)	Red. Factor f <sub>T,Summer</sub>	H <sub>summer</sub> Heat Conducance
1. Exterior Wall - Ambient	A	230,4	0,108	0,92	= 23,0
2. Exterior Wall - Ground	B	116,3	0,099	1,00	= 11,5
3. Roof/Ceiling - Exterior	D	12,5	0,086	0,62	= 7,3
6.	A			0,92	=
7.	X			0,69	=
8. Windows	A	46,2	0,856	1,00	= 39,5
9. Exterior Door	A	5,0	0,650	1,00	= 3,2
10. Exterior Thermal Bridge	A	158,2	-0,032	0,92	= -4,7
11. Perimeter Thermal Bridge	P	43,7	-0,020	1,00	= -0,9
12. Ground Thermal Bridge	B			1,00	=

The capacity for buffering energy depends on the used materials.

Exterior Heat Flow Coefficient,  $H_{T,e}$

W/K

Ground Heat Flow Coefficient,  $H_{T,g}$

W/K

Source:

# Working with PHPP Inputs to PHPP – First result summer comfort (House F.)

## Wellbeing without overheating (sheet Summer)

Orientation of the Area	Angle Factor Summer	Shading Factor Summer	Back Reflection	g-Value (perp. radiation)	Area m <sup>2</sup>	Glazing Fraction	Aperture m <sup>2</sup>
1. East	0,84	0,87	0,95	0,52	8,3	76%	2,3
2. South	0,84	0,55	0,95	0,52	29,1	72%	4,9
3. West	0,84	0,76	0,95	0,52	6,6	76%	1,6
4. North	0,84	0,63	0,95	0,52	2,1	67%	0,4
5. Horizontal	0,84	1,00	0,95	0,00	0,0	0%	0,0

Heat Gains Solar Radiation  $Q_s$

Total 9,1

Interior Heat Sources  $Q_i$

Specif. Power  $q_i$  W/m<sup>2</sup> \*  $A_{TFA}$  m<sup>2</sup> = W  
 2,10 \* 165 = 347

Frequency of Overheating  $h_{\vartheta \geq \vartheta_{max}}$  **11,3%** at an overheating limit of  $\vartheta_{max} = 25^\circ\text{C}$

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

If the value is over 10% go to sheet Summer-S and put in some roller blinds.

Working with PHPP  
Inputs to PHPP – Heat requirement

Criteria 1 - Specific annual heat demand:

Energy used for space heating is

$$< 15 \text{ kWh}/(\text{m}^2\text{a})$$



*A passive house is a building with such a low heating load that it can be heated by the anyway existing ventilation system.*

Source:

# Working with PHPP

## Inputs to PHPP – Result transmission heat losses (House F.)

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> kKh/a	kWh/a	Treated Floor Area
1. Exterior Wall - Ambient Air	A	228,2	0,104	1,00	84,0	1997	}
2. Exterior Wall - Ground	B	116,3	0,120	0,50	84,0	588	
3. Roof/Ceiling - Exterior Air	D	122,5	0,101	1,00	84,0	1040	
4. Floor Slab	B			0,50			
5.	A			1,00			
6.	A			1,00			
7.	X			0,75			
8. Windows	A	48,4	0,717	1,00	84,0	2915	
9. Exterior Door	A	2,5	0,647	1,00	84,0	135	
10. Exterior Thermal Bridge (l)	A	162,0	-0,036	1,00	84,0	-493	
11. Perimeter Thermal Bridge (P)	P	44,5	-0,020	0,50	84,0	-37	
12. Ground Thermal Bridge (len)	B			0,50			
Total of all building envelope areas		515,4					
<b>Transmission Heat Losses Q<sub>T</sub></b>						Total 6147	kWh/(m <sup>2</sup> a) 36,3

$$Q_T = A * U * f_T * G_T$$

$$\text{oder } Q_T = \Sigma(U_i * A_i * G_{Ti}) + \Sigma(\Psi_i * l_i * G_{Ti})$$

f<sub>T</sub> Temp. Factor (reduction faktor)

G<sub>T</sub> Heating degree hours: Difference of the temperature between inside and outside added up hour by hour all over the heating time.

(different in different climate regions)

Source:

## Working with PHPP Inputs to PHPP – Result ventilation losses (House F.)

<b>Ventilation System:</b>		Effective Air Volume $V_{RAx}$	$A_{TFA}$ m <sup>2</sup>	*	Room Clearance m	=	m <sup>3</sup>	
Actual Efficiency of Heat Recovery	$\eta_{eff}$	83%	169,5		2,50		423,8	
Efficiency of Subsoil Heat Exchanger	$\eta_{SHX}$	20%						
		Energetically Effective Air Exchange $n_v$	$n_{v,system}$ 1/h	(1 - $\Phi_{HR}$ )	+ $n_{v,Res}$ 1/h	=	1/h	
			0,309	(1 - 0,86)	+ 0,028	=	0,071	
<b>Ventilation Heat Losses <math>Q_V</math></b>		$V_V$ m <sup>3</sup>	$n_v$ 1/h	*	$C_{Air}$ Wh/(m <sup>3</sup> K)	*	$G_T$ kWh/a	= kWh/(m <sup>2</sup> a)
		424	0,071	*	0,33	*	84,0	= 831
								4,9
<b>Total Heat Losses <math>Q_L</math></b>		$Q_T$ kWh/a	+ $Q_V$ kWh/a	)	Reduction Factor Night/Weekend Economy	=	kWh/a	kWh/(m <sup>2</sup> a)
		( 6147	+ 831	)	1,0	=	6978	41,2

$$Q_V = V_V * n_V * c_p \rho * G_T$$

$V_V$ : exchange volume of the ventilation system

$n_V$ : energetic operative air change

$c_p \rho$  : specific heat capacity of air (capability of containing heat = 0.33 Wh/m<sup>3</sup>K (the potential))

<b>Total Heat Losses <math>Q_L</math></b>	(	$Q_T$ kWh/a	+	$Q_V$ kWh/a	)	Economy	=	kWh/a	kWh/(m <sup>2</sup> a)
		6147		831		1,0	=	6978	41,2

$$Q_L = Q_T + Q_V$$

Source:

## Working with PHPP Inputs to PHPP – Result solar heat gains (House F.)

Orientation of the Area	Reduction Factor see Windows	g-Value (perp. radiation)	Area m <sup>2</sup>	Global Radiation Heating Period kWh/(m <sup>2</sup> a)	kWh/a
1. East	0,50	0,52	8,33	185	402
2. South	0,40	0,52	29,14	356	2149
3. West	0,42	0,52	6,64	275	399
4. North	0,30	0,52	4,28	145	97
5. Horizontal	0,40	0,00	0,00	360	0
<b>Total</b>					<b>3047</b>

kWh/(m<sup>2</sup>a)  
18,0

Gross Solar Heat Gains  $Q_S$

$$Q_S = r * g * A_F * G$$

- r: reductions factor of shading, dirt and angle to the sun
- g: solar heat gain coefficient of the glasses with vertical sun transit
- G: global radiation during the heating days. (slide climate data)

Source:

# Working with PHPP Inputs to PHPP – Result internal heat gains and heat requirement

	kh/d	Heating Period d/a	Specif. Power $q_i$ W/m <sup>2</sup>	$A_{TFA}$ m <sup>2</sup>	kWh/a	kWh/(m <sup>2</sup> a)
<b>Internal Heat Sources <math>Q_i</math></b>	0,024	* 225	* 2,10	* 169,5	= 1922	11,3
					$Q_S + Q_i =$	
					4969	29,3
					$Q_F / Q_L =$	
					0,71	
Utilization Factor Heat Gains $\eta_G$					$(1 - (Q_F / Q_L)^5) / (1 - (Q_F / Q_L)^6) =$	
					94%	
<b>Heat Gains <math>Q_G</math></b>					$\eta_G * Q_F =$	
					4668	27,5

## Heating of persons and equipment

Slide IHS

**Annual Heat Requirement  $Q_H$**

$Q_L - Q_G =$  2310 **14**

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

Requirement met? **Yes**

$$Q_H = Q_T + Q_V - \eta^*(Q_S + Q_i)$$

$\eta$  : utilization factor heat gains

Source:

## Working with PHPP Inputs to PHPP – Heat load

Criteria 2 – Heat load:

power used to heat the building is  $10 \text{ W/m}^2$   
(normally 100!)



***The critical days are***

- ***A very cold but sunny day***
- ***or a moderate cold day but nearly without any sun***

Source:

# Working with PHPP Inputs to PHPP – Result heat load (House F.)

cold but  
clear day

moderate but  
bleak day

Nr. Heat Load Region	0 Standard chosen					CI					
Design Temperature		Radiation:									
Weather Condition 1:	-6,0 °C	East	South	West	North	Horizontal					
Weather Condition 2:	-1,0 °C	15	50	15	5	5	W/m²				
Ground Design Temperature	10,0 °C	5	5	5	5	5	W/m²				
Building Elements	Temperature Zone	m²	U-Value	Factor	Temp. Diff. 1	Temp. Diff. 2	P <sub>T</sub> 1	P <sub>T</sub> 2			
			W/(m²K)	always 1 (except "X")	K	K	Watt	Watt			
1. Exterior Wall - Ambient	A	228,2	0,104	1,00	26,0	or 21,0	618	499	or		
2. Exterior Wall - Ground	B	116,3	0,120	1,00	10,0	or 10,0	140	140	or		
3. Roof/Ceiling - Exterior	D	122,5	0,101	1,00	26,0	or 21,0	322	260	or		
4. Floor Slab	B			1,00	10,0	or 10,0			or		
5.	A			1,00	26,0	or 21,0			or		
6.	A			1,00	26,0	or 21,0			or		
7.	X			0,75	26,0	or 21,0			or		
8. Windows	A	48,4	0,717	1,00	26,0	or 21,0	902	729	or		
9. Exterior Door	A	2,5	0,647	1,00	26,0	or 21,0	42	34	or		
10. Exterior Thermal Bridge (le	A	162,0	-0,036	1,00	26,0	or 21,0	-153	-123	or		
11. Perimeter Thermal Bridge (l	P	44,5	-0,020	1,00	10,0	or 10,0	-9	-9	or		
12. Ground Thermal Bridge (leng	B			1,00	10,0	or 10,0			or		
13. House/Apartment Separating	I	0,0		1,00	3	or 3			or		

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

Total = 1863 or 1530

## Ventilation System:

Effective Air Volume, V <sub>RAx</sub>	m²	m	m³
169,5	*	2,50	= 424
Efficiency of Heat Recovery of the Heat Exchanger	η <sub>HR</sub>	83%	
Efficiency of Heat Recovery of the Subsoil Heat Exchanger	η <sub>SHX</sub>	20%	
Energytically Effective Air Exchange	n <sub>v</sub>	0,309	
		(1 - 0,86)	+ 0,070
		=	0,113

Ventilation Heat Load P <sub>V</sub>	V <sub>V</sub>	n <sub>v</sub>	c <sub>Air</sub>	Temp. Diff. 1	Temp. Diff. 2	P <sub>V</sub> 1	P <sub>V</sub> 2
	m³	1/h	Wh/(m³K)	K	K	W	W
	423,8	* 0,113	* 0,33	* 26,0	or 21,0	= 410	or 331

Source:

# Working with PHPP

## Inputs to PHPP – Result heat load (House F.)

### Total Heat Load $P_L$

Orientation of the Area	Area $m^2$	g-Value (perp. radiation)	Reduction Factor see Windows	Radiation 1 $W/m^2$	Radiation 2 $W/m^2$	$P_S$ 1 $W$	$P_S$ 2 $W$
1. East	8,3	* 0,5	* 0,5	* 15,0	or 5	= 33	or 11
2. South	29,1	* 0,5	* 0,4	* 50,0	or 5	= 302	or 30
3. West	6,6	* 0,5	* 0,4	* 25,7	or 5	= 37	or 7
4. North	4,3	* 0,5	* 0,3	* 5,0	or 5	= 3	or 3
5. Horizontal	0,0	* 0,0	* 0,4	* 5,0	or 5	= 0	or 0

### Heat Gain - Solar Heat Load, $P_S$

Total = **375** W or **52** W

### Internal Heat Load $P_I$

Specif. Power $W/m^2$	$A_{TFA}$ $m^2$	$P_I$ 1 $W$	$P_I$ 2 $W$
1,6	170	= 271	or 271

### Heat Gains $P_G$

$P_S + P_I$	$P_G$ 1 $W$	$P_G$ 2 $W$
=	646	or 323
$P_L - P_G$	=	1627 or 1538

### Annual Heat Load $P_H$

= **1627** W

### Floor Space Specific Annual Heat Load $P_H / A_{TFA}$

= **9,6**  $W/m^2$

$P_H$ : Heat load. Maximum „very cold but sunny day“ or „moderate day without sun“

$A_{TFA}$ : Treated floor area (TFA)

Source:

# Working with PHPP

## Inputs to PHPP – Result heat load (House F.)

### PHPP heat load - last line

Annual Heat Load  $P_H$

$$P_L - P_G = 1627 \text{ or } 1538$$

$$= 1627 \text{ W}$$

Floor Space Specific Annual Heat Load  $P_H / A_{TFA}$

$$= 9,6 \text{ W/m}^2$$

Max. supply air temperature input  °C

Supply air temp. w/o supplementary heating  $\vartheta_{\text{supply,min}}$  16 °C

Max. Supply Air Temp.  $\vartheta_{\text{sup,max}}$  52 °C

Compare: Heat load that can be transported by supply air.  $P_{\text{Supply Air,Max}}$

$$= 1536 \text{ W specific: } 9,1 \text{ W/m}^2$$

In this case the heat load is to small.  $P_{\text{Supply Air, max.}} < P_H$

Source: