PHPP

BRIEF INSTRUCTIONS

For use in EuroPHit, c

Place your mouse here to see the PHPP help.

If no help appears when the mouse passes over cell B4, you can activate it by going into the Menu Bar Tools/Options/View, and under "Comments", select "Comment Indicator Only".

Passive House Verification: Meaning of Field Formats

Example	Field Format	Meaning
78,8	Courier New, blue, bold on yellow background	Input Field: Please enter the required value here
01ud tripple-low-e-cr08	Arial Narrow, blue, bold on brown	Data entry field with drop down list
6619	Arial, black, standard on white background	Calculation field; please do not change
78,8	Courier New, purple, bold on white background	Field with references to another sheet - should not be changed.
126,0	Arial, black, large & bold on green background	**Important result**

Passive House Planning: Worksheet Directory

Worksheet name (to show/hide worksheets please use the separate 'Profile settings' tool)	Function	Brief Description	Required for the certification?
Verification	Building data; summary of results	Building description, selection of the calculation method, summary of results	yes
Overview	Overview of the specific data of the project entered	In-depth project description, overview of all results and input variables, specific details on building envelope, building services systems as well as general information.	no
Variants	Variant calculation	Input parameters and results for the variant calculations. Predefined fields for frequent entries, as well as user-defined area.	no
Comparison	Comparison between two variants	Comparison between two variants under the energy demand and economic viability perspective. Input of comparison configurations.	no
Climate	Climate Region Selection or Definition of User Data	Climate data for: Annual Heating, Windows, Heating Load, Heating, Summer, Cooling, Cooling Units, Cooling Load worksheets	yes
U-Values	Calculation of Standard building assembly U-Values	Heat transmission coefficient calculations in accordance with DIN EN ISO 6946.	yes
Areas	Areas summary	Building assembly Areas, Thermal Bridges, Treated Floor Area. Use exterior dimension references!	yes
Ground	Calculation of reduction factors against ground	More precise calculation of heat losses through the ground	if applicable
Components	Building component database	Database of certified, Passive House suitable components and entry of user-defined components	yes
Windows	U_W-Value Determination	Input of geometry, orientation, frame lengths, frame widths, U_g and U-values of the frame, and the thermal bridge heat loss coefficients of the connections; from these inputs, determine U_W and total radiation.	yes
Shading	Determination of shading coefficients	Input of shading parameters, e.g. balcony, neighbouring building, window reveal and calculating the shading factors	yes
Ventilation	Air Flow Rates, Exhaust/Supply Air Balancing, Pressurization Test Results	Sizing the ventilation system from extract and supply air requirements, infiltration air change rate and actual efficiency of heat recovery, input of pressurization test results	yes
Additional Vent	Design and planning of ventilation systems with diverse ventilation units	Extension of the Ventilation worksheet for dimensioning air flows, for special building uses and systems with various ventilation units	if used
Annual heating	Annual heating demand / Annual Method	Calculation of the annual space heating demand according to the energy balance method following EN 13790: Transmission + Ventilation - h (Solar Gains + Internal Gains)	no
Heating	Space heating demand calculation Monthly method according to EN 13790	Calculation procedure for the monthly method following EN 13790. Make appropriate selection in the Verification worksheet, if calculations should be performed following this procedure	yes
Heating Load	Building Heating Load Calculation	Calculation of the nominal heating load using a balance procedure for the design day: max transmission + max ventilation - η (minimum solar gains + internal heat gains)	yes
SummVent	Determination of Summer Ventilation	Ventilation in cooling case and estimation of air flow rates for natural ventilation during the summer period	yes
Summer	Assessment of Summer Climate	Calculation of the frequency of overheating as a measure of summer comfort	yes
Cooling	Monthly Method for Cooling Demand	Annual useful cooling demand calculation	if present
Cooling units	Latent Cooling Energy	Calculation of the energy demand for dehumidification and choice of cooling method	if present
Cooling load	Building Cooling Load Calculation	Calculation of the daily average cooling load of the building	no
DHW+Distribution	Distribution losses; DHW Requirement and Losses	Heat loss calculation of the distribution systems (heating; DHW); calculation of the useful heat requirement of DHW and storage losses	yes
SolarDHW	Solar DHW Heating	Solar contribution calculation for DHW and space heating contribution	if solar panels are used
PV	Electricity generation by photovoltaic	Electricity generation calculation of PV system	no
Electricity	Electricity Demand for Dwellings	Calculation of the electricity demand of Passive Houses with residential use	yes
Use non-res	Patterns of non-residential Utilisation	Input or selection of utilisation patterns for planning of electricity demand and internal heat gains	no
Electricity non-res	Electricity Demand for non-residential Use	Calculation of the electricity demand for lighting, electric devices and kitchens for non-residential buildings	no
Aux Electricity	Auxiliary Electricity Demand	Calculation of auxiliary electricity and corresponding primary energy demand	yes
IHG	Internal Heat Gains in Dwellings	Calculation of the internal heat gains based on the Electricity and Aux Electricity sheets.	no
IHG non-res	Internal Heat Gains for non-residential Use	Calculation of the internal heat gains for non-residential buildings based on the Electricity non-res worksheet and the occupancy	no
PE-Value	Specific Primary Energy and CO_2 Demands	Selection of heat generators, calculation of the specific primary energy and CO2 demands from the present results	yes
Compact	Efficiency of Heat Generator Compact Heat Pump Unit	Calculation of combined heat generation efficiency for heating and DHW only by means of a electric heat pump compact unit, considering the specific project boundary conditions.	if present
HP	Heat generation efficiency of the heat pump	Calculation of heat generation efficiency for one to two electric-run heat pumps, considering the specific project boundary conditions.	if present
HP Ground	Ground probe or ground collector in combination with a heat pump	Heat source calculation for a ground probe or horizontal subsoil heat exchanger for ground-coupled heat pumps, considering the specific project boundary conditions.	if present
Boiler	Efficiency of Heat Generator Boiler	For the calculation of the efficiency of heat generation with standard boilers (NT and calorific boilers) for the project given boundary conditions.	if present
District Heating	District Heat Transfer Station	Calculation of the final and primary energy demands (heat)	if present
Data	Database	Table of primary energy factors following [GEMIS] and database of EnEV (German energy efficiency regulation).	no

EnerPHit verification

Building:	School "Tzanko Diustabanov"-Block A
Street:	25 Hristo Smirnenski blv.
Postcode/City:	Gabrovo
Country:	Bulgaria
Building type:	School
Climate:	Велико Търнов PHI
Altitude of building site (in [m] above sea level):	382
Home owner/client:	Municipality of Gabrovo
Street:	3 Vazrazhdane square
Postcode/City:	Gabrovo

Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	20,0	Interior temp. summer [C°]	25,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	2,8	IHG summer [W/m²]	2,8
Number of Occupants:	225,0			Spec. capacity [Wh/K per m² TFA]	204
Exterior vol. V_e:	6224,4 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	1303,5	m²		
Space heating	Annual heating demand	**250**	**kWh/(m²a)**	25 kWh/(m²a)	**no**
	Heating load	**105**	**W/m²**	-	**-**
Space cooling	Overall specific space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 25 °C)	9,6	%	-	**-**
Primary Energy	Heating, cooling, dehumidifying, DHW, auxiliary electricity, lighting, elect.	**312**	**kWh/(m²a)**	402 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	259	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**4,0**	**1/h**	1 1/h	**no**

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

EnerPHit building retrofit (acc. to heating demand)? **no**

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

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

EnerPHit planning:

PROJECT OVERVIEW

Basic data

Building, name of the object	School "Tzanko Diustabanov"-Block A		
Street:	25 Hristo Smirnenski blv.		
Postcode/City:	Gabrovo		
Country:	Bulgaria		
Building type:			
Climate: region / climate data set	User Data		User data - Вел
Climate: degree days / altitude	74	kKh/a	382
Building type / building status			
Context of urban development			
Building type / construction			
Building category, in terms of energy			
Year of construction / year of construction of existing building	2014		
Amount of dwelling units for residential use / non-residential use		Dwelling units	13
Number of occupants standard / planned		P	225
Standard / design occupancy rate		m²/P	6
Home owner / client	Municipality of Gabrovo		
Architect			
Building services			
PHPP/Energy balance			
Building physics			
Structural engineering			
Contractor / tradesperson / other (max. 5000 characters)			
Interior temperatures winter/summer	20	°C	25
IHG winter / summer	2,8	W/m²	2,8
Type of certification	EnerPHit building retrofit (acc. to heating dem		
Project certification / Certificate ID			
Certification body			
PHPP-version / PHPP-registration number	Version 9.0 beta		

Characteristic value according to EnerPHit verification

Treated floor area A_{TFA} / exterior volume V_e	1303,46	m²	6224,4
	Specific Demand		Requirement
Space heating demand	250	kWh/(m²a)	25
Heating load residential		kWh/(m²a)	-
Heating load Non-residential	105	kWh/(m²a)	-
Frequency of overheating	10	%	Recommendation: < 10%
Overall specific space cooling demand		kWh/(m²a)	-
Cooling load residential		kWh/(m²a)	-
Cooling load non-residential	105	kWh/(m²a)	-
Airtightness pressure air exchange rate test n_{50}	4,0	1/h	1
Total PE Value	312	kWh/(m²a)	402
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			
Specific PE Demand - Mechanical System / CO_2-Equivalent	259	kWh/(m²a)	78
Heating, DHW, auxiliary electricity (no lighting and electrical appliances)			
Solar power: Primary energy savings / CO2 emissions		kWh/(m²a)	

Average building quality

	Specific Demand		Requirement
Average U-value of external insulation to outside air	1,84	W/(m²K)	-
Average U-value of external insulation to ground	2,01	W/(m²K)	-
Average U-value interior insulation to outside air	1,12	W/(m²K)	-
Average U-value interior insulation to ground		W/(m²K)	-
Average U-value of thermal bridges ΔU	-0,05	W/(m²K)	-
Average U-value windows	2,51	W/(m²K)	-
Average U-value of exterior doors	5,50	W/(m²K)	-
Ventilation system eff. heat recovery efficiency		%	-

Building envelope and site

Building envelope area A_{total} / treated floor area A_{TFA}	2901	m²	1303
A/V-ratio / Envelope area use (A_{total}/A_{TFA})	0,47		2,23
Window area / Window area percentage	434	m²	15,0%
Specific solar aperture / Passive solar heating mode	2,9%		22841
Building site area / built-up area		m²	
Gross floor area BGF / Gross external volume BRI		m²	
Floor space ratio / Amount of complete storeys			

Building description (max.5000 characters)

Opaque building components

Exterior wall: U-value (average value) / area	1,33	W/(m²K)	1365,61
Standard exterior wall: U-value / thickness		W/(m²K)	0,0
Standard exterior wall: total area / area fraction		W/(m²K)	
Standard exterior wall: name / certified?			
Standard exterior wall: short description (materials, manufacturer, product name, special features)			
Exterior wall against ground: U-value (average value) / area		W/(m²K)	
Standard exterior wall against ground: U-value / thickness		W/(m²K)	0,0
Standard exterior wall against ground: area / area fraction		W/(m²K)	
Standard exterior wall against ground: name / certified?			
Standard exterior wall against ground: short description (materials, manufacturer, product name, special features)			
Roof / top floor ceiling: U-value (average value) / area	3,07	W/(m²K)	549,78
Standard roof / top floor ceiling: U-value / thickness		W/(m²K)	0,0
Standard roof / top floor ceiling: area / area percentage		W/(m²K)	
Standard roof / top floor ceiling: name / certified?			
Standard roof / top floor ceiling: short description (materials, manufacturer, product name, special features)			

Floor slab / basement ceiling: U-value (average value) / area	2,01	W/(m²K)	549,78
Standard floor slab / basement ceiling: U-value / thickness		W/(m²K)	0,0
Floor slab / basement ceiling standard: area / area fraction		W/(m²K)	
Standard floor slab / basement ceiling: name / certified?			
Standard floor slab / basement ceiling: short description (materials, manufacturer, product name, special features)			
Thermal bridges: Y-value (Average value) / length	-0,241	W/(mK)	707,26
Thermal bridge free limit value / Complied?	0,01	W/(mK)	yes
Thermal bridges: short description (max.5000 letters) (additional notices, manufacturer, product name, materials, others)			

Windows / doors / shading systems

windows/facades: U-value (average value) / area	2,51	W/(m²K)	433,78
window/facade frames: U-value (average value) / area	1,73	W/(m²K)	220,13
Glazing: U-value (Average value) / areas	2,90	W/(m²K)	213,65
Ψ-Value Glazing edge (average) / Ψ-Value Installation (average)	0,041	W/(mK)	0,040
Standard window frame: U-value / frame width		W/(m²K)	
Standard window frame: window area / area percentage		W/(m²K)	
Standard window frame: glass edge Ψ-value / installation Ψ-value		W/(mK)	
Standard window frame: name, certified?			
Standard window frame: Short description (materials, manufacturer, product name, installation)			
Standard curtain wall facade: U-value / Frame width		W/(m²K)	
Standard curtain wall facade: Facade area / Total area percentage		W/(m²K)	
Standard curtain wall facade:Ψ-value glazing edge / Ψ-value installation		W/(mK)	
Standard curtain wall facade: Description / Certified?			
Standard curtain wall facade: short description (materials, manufacturer, product name, installation)			
Standard glazing: U-value / g-value		W/(m²K)	
Standard glazing: Facade area / Area ratio		W/(m²K)	
Standard glazing: Description / Certified?			
Standard glazing: short description (description, manufacturer, product name, installation)			
Standard glazing 2: U-value / g-value		W/(m²K)	
Standard glazing 2: Facade area / Area percentage		W/(m²K)	
Standard glazing 2: Description / Certified?			
Standard glazing 2: short description (description, manufacturer, product name, installation)			
Roof lights / light domes: U-value / frame width		W/(m²K)	
Roof lights / light domes: window area / area section		W/(m²K)	
Roof lights / light domes: glazing U-value / g-value		W/(m²K)	
Roof lights / light domes: Y-value glass edge / Installation Y-value		W/(mK)	
Roof lights / light domes: name / certified?			
Roof lights / light domes: short description (materials, manufacturer, product name, installation situation)			
Exterior door: U-value (average value) / Area	5,50	W/(m²K)	2,00
Standard exterior door: door U-value / door U-value installed		W/(m²K)	
Standard exterior door: frame U-value / door leaf U-value		W/(m²K)	
Standard exterior door: door leaf thickness / frame width		mm	
Standard exterior door: panel border Y-value / installation Y-value		W/(mK)	
Standard exterior door: Name / certified?			
Standard exterior door: Short description (materials, manufacturer, product name, installation situation)			
Temporary sun protection: Type / Add. Reduction factor		W/(m²K)	5,97
Temporary sun protection: Area / Area ratio		W/(m²K)	

Shading reduction factors: orientation	Reduction factor winter		Summer reduction factor
North	63	%	68
East	58	%	70
South	75	%	64
West	70	%	83
Horizontal	100	%	100

Ventilation

Ventilation: Type of ventilation	Window ventilation only		
Calculated supply air demand / supply air per person	6750	m³/h	30
Calculated extract air demand / Amount extract air rooms	0	m³/h	
Design air flow rate (maximum) / Average value reference to maximum		m³/h	77
Average flow rate / Average air exchange		m³/h	
Airtightness test pressure at n_{50} / Air permeability q_{50}	4,00	1/h	
Net air flow for pressurization test / Infiltration flow $n_{V,Rest}$		m³	
Ventilation unit: Description / Certified?			
Ventilation system: effective heat recovery efficiency / electrical efficiency		%	
Ventilation system: Description (type of heat recovery, manufacturer, product name)			
Ventilation system: installation site / Temperature of mechanical services room			
Nominal width exterior or supply air / exhaust or extract air ducts		mm	
Conductance ambient- or supply air duct / exhaust- or extract air duct		W/(mK)	
Length ambient- or supply air duct / exhaust- or extract air duct		m	
SHX: efficiency / effective heat recovery efficiency		%	0,00
HE defrosting / Defrosting at a minimum temperature of			
Effective energy recovery efficiency ventilation / Humidity recovery		%	#WERT!
Ventilation system: Short description (installation site, ducts, silencers, others)			

Summer ventilation

Summer base ventilation: ventilation type		
Air exchange via ventilation system with supply air:		0,00
Air exchange via extract air system		0,00
Window ventilation air exchange		0,46
Night summer ventilation: Type of ventilation		
Night air exchange Window Night Ventilation, Manual		0,40
Night air exchange mechanical, automatically Controlled ventilation	Humidity differenceregulated	0,00
Summer ventilation: short description (window opening profiles, night ventilation concepts, others)		

Cooling

Max. indoor absolute humidity / Internal humidity sources	12,0	g/kg	2,0
Frequency of overheating / Overtemperature limit:	9,6	%	25,0
Mechanical cooling: Applied cooling units			
		kW	
		kW	
	0,0		
		kWh/(m²a)	
Mechanical cooling: Average annual coefficient of performance / Electricity demand			0,0
Mechanical cooling: Short description (unit, manufacturer, product name, installation site, installation)			

Heating and DHW

DHW Demand	**38,25**	kWh/(m²a)	**49863**
Annual heating demand	**250,68**	kWh/(m²a)	**326747**
Direct electricity: contribution to space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
Direct electric heating / domestic hot water			
Final energy demand		kWh/(m²a)	
Direct electricity: short description (description, manufacturer, product name)			
Heat pump: covered fraction of space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
COP heat pump for heating / heat pump for DHW			
Final energy demand		kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			
Compact unit: covered fraction of space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
COP heat pump for heating / heat pump for DHW			
Final energy demand		kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			
Boiler: covered fraction of space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
Heat generator: building type / COP			
Final energy demand		kWh/(m²a)	
Boiler: short description (description, manufacturer, product name)			
District heating: Covered fraction of space heating / domestic hot water	100	%	100
PE value energy carrier / CO_2-emission factor	0,8	kWh/kWh	240
Heat source / Performance of heat generator	Hard Coal CGS 70% PHC		111,0
Final energy demand	320,7	kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			

Solarthermics

Collector	7 Improved flat plate collector		
Collector area / Specific collector area	0,00	m²	0,00
Deviation from north / Angle of inclination from the horizontal	180	°	45
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Solar contribution to DHW	**0,00**	kWh/(m²a)	**0**
Solar contribution to space heating	**0,00**	kWh/(m²a)	**0**
Solar contribution total	**0,00**	kWh/(m²a)	**0**
Solar Storage	9 Simple solar storage		

PHOTOVOLTAIC

Module technology	Amorph-Si		
Nominal current / Nominal voltage		A	
Nominal power / Number of modules	0,00	Wp	
Deviation from north / Angle of inclination from the horizontal		°	
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Annual yield of PV modules		kWh/(m²a)	

Aux. electricity / Household electricity

Aux Electricity

Ventilation units / Electricity demand		
Heating system Devices / Electricity demand		973
DHW-system units / Electricity demand		321
Aux. Electricity solar devices / electr. demand		
Total aux. Electricity	**0,99** kWh/(m²a)	**1294,43**

Household electricity

Dishwasher / useful energy demand		16088
Washing machine units / Energy demand		14108
Clothes dryer unit / Energy demand		39277
Refrigerator, Freezer or combination unit / Useful energy demand		574
Cooking unit / energy demand		28125
Lighting		39150
Consumer Electronics		9900
Small appliances, etc.		11250
Other		
Total household electricity	**121,58** kWh/(m²a)	**158470,34**

Economic data

Total gross construction costs / contained VAT	€	
Building costs (cost group 300+400) / (cost group 200-700)	€	
Total gross construction costs per m² BGF / per m³ BRI	€/m²	
Explanation building costs		
Fostering (Passivhaus, refurbishment, etc.)		
Explanation fostering		

Other

Ecological aspects: rainwater utilization, etc.	
Material used: Regional products / Natural products	
Special features: first project in the country / first project used as	
Building awards	
Research project / funded project	
Description of research / funded project	
Other	

EnerPHit planning:

select active variants
>>

Results	Units
Annual heating demand	kwh/(m²a)
Heating Load	W/m²
Overall specific space cooling demand	kwh/(m²a)
Cooling load	W/m²
Frequency of overheating	%
Total primary energy demand	kwh/(m²a)
Certifiable as EnerPHit building retrofit (acc. to heating demand)?	yes / no
<< User defined	Units

Input variables	Units
<< Assembly layers ('U-value')	
a Exterior roof insulation	W/(mK)
	mm
b New hydroinsulation	W/(mK)
	mm
c	W/(mK)
	mm
d Exterior roof insulation	W/(mK)
	mm
e New hydroinsulation	W/(mK)
	mm
f Cement	W/(mK)
	mm
g	W/(mK)
	mm
h Wall exterior insulation	W/(mK)
	mm
i New outside plaster	W/(mK)
	mm
j Stone	W/(mK)

		mm
k	**Wall insulation Block A1**	W/(mK)
		mm
l	**New plaster lock A1**	W/(mK)
		mm
m		W/(mK)
		mm
n	**Basement insulation**	W/(mK)
		mm
o		W/(mK)
		mm
p	**Floor insulation on Block A connection**	W/(mK)
		mm
q	**New flooring**	W/(mK)
		mm
r		W/(mK)
		mm
s		W/(mK)
		mm
t		W/(mK)
		mm
u		W/(mK)
		mm
v		W/(mK)
		mm
w		W/(mK)
		mm
x		W/(mK)
		mm
y		W/(mK)
		mm
z		W/(mK)
		mm

<< Radiation balance ('Areas')

<< Thermal bridges ('Areas')

<< Glazing and frames ('Window', 'Shading')

a	**Wooden frame**	
	Active variants: *g-Value:0,77* *U-Value: 2,8 W/(m²K)*	Glazing
	U-Value [W/(m²K]: Left: 1,6 Right: 1,6 Bottom: 1,6 Top: 1,6 *Width [m]: Left: 0,14 Right: 0,14 Bottom: 0,14 Top: 0,14*	Frame

	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
b	**Wooden frame - shaded**	
	Active variants: *g-Value:0,77* *U-Value: 2,8 W/(m²K)*	Glazing
	U-Value [W/(m²K]: Left: 1,6 Right: 1,6 Bottom: 1,6 Top: 1,6 *Width [m]: Left: 0,14 Right: 0,14 Bottom: 0,14 Top: 0,14*	Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
c	**Wooden frame shaded door**	
	Active variants: *g-Value:0,77* *U-Value: 2,8 W/(m²K)*	Glazing
	U-Value [W/(m²K]: Left: 1,6 Right: 1,6 Bottom: 1,6 Top: 1,6 *Width [m]: Left: 0,14 Right: 0,14 Bottom: 0,14 Top: 0,14*	Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
d	**PVC frame**	
	Active variants: *g-Value:0,77* *U-Value: 2,7 W/(m²K)*	Glazing
	U-Value [W/(m²K]: Left: 1,8 Right: 1,8 Bottom: 1,8 Top: 1,8 *Width [m]: Left: 0,14 Right: 0,14 Bottom: 0,14 Top: 0,14*	Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
a		

		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
e	**Metal frame**	
	Active variants: *g-Value:0,87* *U-Value: 5,8 W/(m²K)*	Glazing
	U-Value [W/(m²K]: Left: 5,5 Right: 5,5 Bottom: 5,5 Top: 5,5 *Width [m]: Left: 0,14 Right: 0,14 Bottom: 0,14 Top: 0,14*	Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
f		
		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
g		
		Glazing
		Frame

	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
h		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
i		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
j		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
k		

		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
l		
		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
m		
		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
n		
		Glazing
		Frame

	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
o		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
p		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
q		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
r		

		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
s		
		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
t		
		Glazing
		Frame
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
u		
		Glazing
		Frame

	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
v		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
w		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
x		
	Glazing	
	Frame	
	Window reveal depth	m
	Distance from glazing edge to reveal	m
	Overhang depth	m
	Distance of the upper edge of glazing to the overhang	m
	Reduction factor for temporary sun protection	%
y		

	Glazing
	Frame
Window reveal depth	m
Distance from glazing edge to reveal	m
Overhang depth	m
Distance of the upper edge of glazing to the overhang	m
Reduction factor for temporary sun protection	%

z

	Glazing
	Frame
Window reveal depth	m
Distance from glazing edge to reveal	m
Overhang depth	m
Distance of the upper edge of glazing to the overhang	m
Reduction factor for temporary sun protection	%

<< Ventilation ('Ventilation', 'SummVent')

Ventilation type	select
Air Change Rate at press. Test (n_{50})	1/h
Design air flow rate (maximum)	m³/h
Installation site of ventilation unit	Inside/Outside
Ventilation unit selection	select

Summer background ventilation to ensure adequate air quality

Air exchange via ventilation system with supply air:		1/h
HR/ER in summer (check one field only):	none	check as appropriate
	automatic bypass, controlled by temperature difference	check as appropriate
	automatic bypass, controlled by enthalpy difference	check as appropriate
	always	check as appropriate

Air exchange via extract air system	1/h
Specific power consumption (for extract air system)	Wh/m³
Window ventilation air exchange	1/h

Additional summer ventilation for cooling

CALCULATION OF VARIANTS

Active

1-No measures	No measures	Block A: Roof ins. Block A1: Walls ins., Changing windows, Shading, periferial ins.	Block A: Walls ins., Changing windows, shading Block A1: Roof ins. HVAC: Ventilation, Repearing heating	New heat source, new DHW system
1	1	2	3	4
250,1	250,1	188,6	24,2	24,2
105,1	105,1	80,2	16,1	16,1
9,6	9,6	9,1	8,2	8,2
312,4	312,4	257,8	128,8	124,0
no	no	no	yes	yes
Link	Link	Link	Link	Link

Value	1	2	3	4
0		0,035	0,035	0,035
0		300	300	300
0		0,17	0,17	0,17
0		0,06	0,06	0,06
0				
0				
0			0,035	0,035
0			300	300
0			0,17	0,17
0			0,06	0,06
0			0,93	0,93
0			100	100
0				
0				
0			0,032	0,032
0			250	250
0			0,87	0,87
0			20	20
0			1,06	1,06

0			40	40
0		0,032	0,032	0,032
0		250	250	250
0		0,87	0,87	0,87
0		20	20	20
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				
0				

Go to glazing list

Go to window frames list

97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/5	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer
54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V

0,150	0,15	0,15	0,16	0,16
0,120	0,12	0,12	0,131	0,131
0,150	0,15	0,15	0,16	0,16
0,120	0,12	0,12	0,131	0,131
			60%	60%

Go to glazing list Go to window frames list

97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/5	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer
54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V
0,250	0,25	0,25	0,25	0,25
0,120	0,12	0,12	0,131	0,131
0,250	0,25	0,25	0,25	0,25
0,120	0,12	0,12	0,131	0,131
			60%	60%

Go to glazing list Go to window frames list

97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/4	97ud Double glazing 4/30mm air/5	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer
54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	54ud EXISTING: timber 68 mm	0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V	0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V
0,500	0,5	0,5	0,5	0,5
0,120	0,12	0,12	0,156	0,156
0,500	0,5	0,5	0,5	0,5
0,120	0,12	0,12	0,156	0,156

Go to glazing list Go to window frames list

94ud Double glazing 4/16mm air/4	94ud Double glazing 4/16mm air/4	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer
56ud EXISTING: synthetic before 1998	56ud EXISTING: synthetic before 1998	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V	0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V
0,150	0,15	0,25	0,25	0,25
0,140	0,14	0,131	0,131	0,131
0,150	0,15	0,25	0,25	0,25
0,140	0,14	0,131	0,131	0,131
		60%	60%	60%

Go to glazing list Go to window frames list

[Go to glazing list](#) [Go to window frames list](#)

92ud Single glazing	92ud Single glazing	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer	01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer
60ud EXISTING: metal, no thermal break, paint finish	60ud EXISTING: metal, no thermal break, paint finish	0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V	0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V	0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V
0,150	0,15	0,5	0,5	0,5
0,100	0,1	0,156	0,156	0,156
0,150	0,15	0,5	0,5	0,5
0,100	0,1	0,156	0,156	0,156

[Go to glazing list](#) [Go to window frames list](#)

[Go to glazing list](#) [Go to window frames list](#)

Go to glazing list Go to window frames list

Window ventilation only	**Window ventilation only**	**Window ventilation only**	**Balanced PH-Ventilation with HR**	**Balanced PH-Ventilation with HR**
4,00	**4**	**3**	**1**	**1**
			Inside the thermal envelope	**Inside the thermal envelope**

Go to ventilation units list

0,00			**0,31**	**0,31**
			x	**x**

0,00			**0,51**	**0,51**
0,00			**0,4**	**0,4**

0,46	**0,46**	**0,46**	**0,07**	**0,07**

0,40	**0,40**	**0,19**	**0,19**	**0,19**
0,00				
0,00				

Basement insulation + LED Lighting				
5	6	7	8	9
24,1				
16,2				
8,4				
98,4				
yes				
Link	Link	Link		

5	6	7	8	9
0,035				
300				
0,17				
0,06				
0,035				
300				
0,17				
0,06				
0,93				
100				
0,032				
250				
0,87				
20				
1,06				

40				
0,032				
250				
0,87				
20				
0,041				
100				

01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer				
0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V				

0,16				
0,131				
0,16				
0,131				
60%				

01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer				
0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V				
0,25				
0,131				
0,25				
0,131				
60%				

01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer				
0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V				
0,5				
0,156				
0,5				
0,156				

01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer				
0081wi03 Rehau - REHAU GENEO PHZ - with Swisspacer V				
0,25				
0,131				
0,25				
0,131				
60%				

01ud 44 mm. triple glazing, 2 Low-E, air, alum.spacer				
0251wi03 RAICO - FRAME+ 90 WB - with Swisspacer V				
0,5				
0,156				
0,5				
0,156				

Balanced PH-Ventilation with HR				
1				
Inside the thermal envelope				

0,31				
x				

0,51				
0,4				

0,07				

0,19				

EnerPHit planning: **C O M P A R I S O N B**

Selection of comparison configuration

Description	6-S2:Walls
Component type	Building assemblies ('U-Value')
Component	01ud Block A - plaster

Calculation of selected configuration

	Lower Efficiency	Hig Effici
Design according to variant	2-Block A: Roof ins.E	3-Block A:
U-Value	1,347	0,1
Minimal interior surface temperature	11,5	19
Design Temperature outside	-9,1	-9
Interior temperature	20,0	20
Normal surface thermal resistance	0,13	0,
Increased Heat Transfer Resistance	0,25	0,
Minimal surface temperature unobstructed	14,8	19

Mould!

			Inves
	Per m² of component	Whole component	Per m² of component
Area of component	1,00	1337	1,00
Investment costs less sum of financial support	10,38	13877	41,46
Annuity (capital costs)	0,56	748	2,23

			Energy (Space heating + c
	Per m² of TFA	Entire building	Per m² of TFA
Area	1	1303	1
Annual heating demand	115,68	150786	24,25
Cooling + dehumidification demand			
Electricity demand:			
Auxiliary electricity for Heating	0,75	973	0,75
Auxiliary electricity ventilation winter	2,31	3009	2,31
Direct electric	0,00	0	0,00
HP	0,00	0	0,00
Compact heat pump unit	0,00	0	0,00
Auxiliary electricity ventilation summer	3,48	4533	3,48

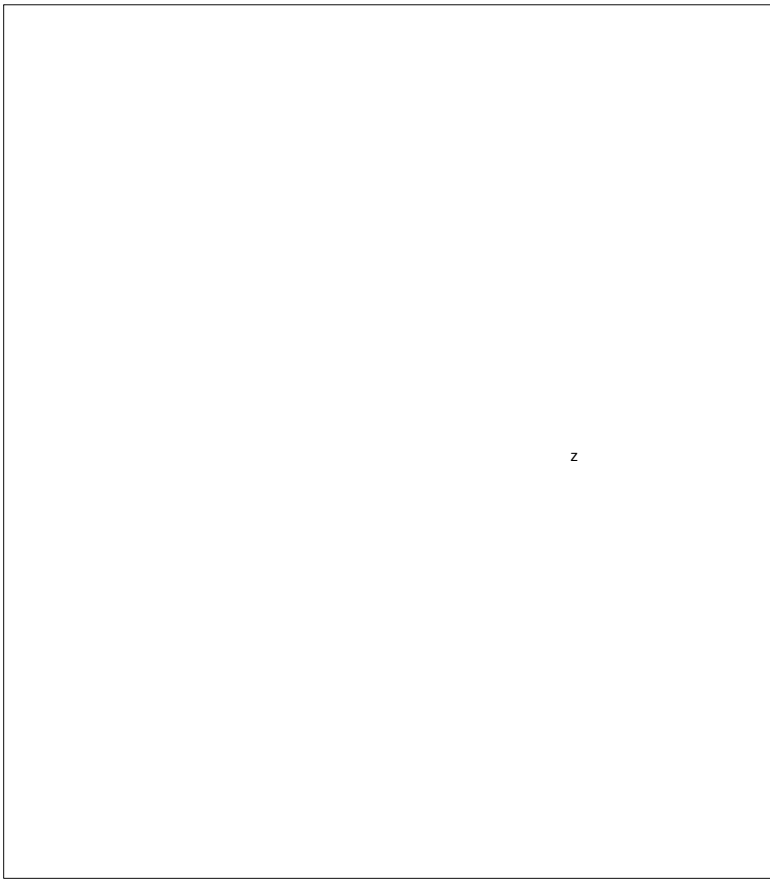
Compressor cooling unit	0,00	0	0,00
Final energy demand:			
Total electricity demand	6,53	8515	6,53
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	129,09	168267	27,62
Others	0,00	0	0,00
CO2-Emissions:			
Total electricity demand	4,44	5790	4,44
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	40384,06	52639001	8639,21
Others	0,00	0	0,00
PE-demand			
Total electricity	16,98	22138	16,98
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	134613,52	290152	28797,38
Others	0,00	0	0,00
Costs:			
Total electricity	0,65	851	0,65
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	7,10	9255	1,52
Others	0,00	0	0,00
Total energy costs	7,75	10106	2,17
Maintenance costs	0,00	0	0,00
Final energy demand	142,16	185296	40,68
CO_2-Emissions	40388,50	52644791	8643,66
Primary energy demand	134630,50	312290	28814,36
Total cost space conditioning	7,75	10106	2,17
			Economi
Total annual costs	8,33	10854	4,46

Maximal economically viable additional i

Cost per kWh of sa

<< Boundary conditions

	Boundary
Interest rate + Inflation	**Energy price**
Nominal interest rate: **6,50%**	Electricity
Inflation: **1,53%**	Gas/Oil
Period under consideration [a]: **20**	Logs
	Pellet
	District heating
	Others



ETWEEN TWO VARIANTS

her iency	Difference / Savings / Profit	
Walls ins.		
l17	W/(m²K)	
),2	°C	
,1	°C	
,0	°C	
13	m²K/W	
25	m²K/W	
),5	°C	

tment			
Whole component	Per m² of component	Whole component	
1337	1,00	1337	m²
55440	31,08	41563	€
2988	**1,67**	**2240**	€/a

ooling + mech. ventilation)			
Entire building	Per m² of component	Whole component	
1303	1	1337	m²
31608	**89,12**	**119178**	kWh/a
			kWh/a

973	0,00	0	kWh/a
3009	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
4533	0,00	0	kWh/a

0	0,00	0	kWh/a

8515	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
35997	98,91	132270	kWh/a
0	0,00	0	kWh/a

5790	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
11260869	30940,88	41378133	kg/a
0	0,00	0	kg/a

22138	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
26917	196,84	263235	kWh/a
0	0,00	0	kWh/a

851	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
1980	5,44	7275	€/a
0	0,00	0	€/a
2831	5,44	7275	€/a
0	0,00	0	€/a

53026	98,91	132270	kWh/a
11266659	30940,88	41378133	kg/a
49055	196,84	263235	kWh/a
2831	**5,58**	**7275**	€/a

c viability			
5819	**3,76**	**5035**	€/a

investment costs	100,94	134991	€
aved final energy	1,7		Cent/kWh

conditions			
s [cent/kWh]	Period of use		
10	Build. assemblies	50	a
6	Vent. system	25	cent/kWh
3	Thermal bridges	50	cent/kWh
4	Complete building	35	a
6	Windows	30	a
20			

Input: comparison configuration

	1	2
Description	S1: Building	S1: Roof
Component type	Complete building	Building assemblies ('U-Value')
Component		10ud Roof type 2 direct to exter
"Lower Efficiency" variant	1-No measures	1-No measures
Investment costs [€]	9274,80	8038,81
Annual maintenance costs [€/a]		
"Higher Efficiency" variant	2-Block A: Roof ins.Block A1: W	2-Block A: Roof ins.Block A1: W
Investment costs [€]	41269,17	17124,60
Annual maintenance costs [€/a]		
Financial support (present value) [€]		

Results (manual transfer)

Description	80715,49	33492,8
	18139,94	15722,55

3	4	5
S1: Walls A1	S1: Windows	S2: Building
Building assemblies ('U-Value')	Windows ('Window')	Complete building
11ud Block A - connection	d-PVC frame	- No additional input
1-No measures	1-No measures	2-Block A: Roof ins.Block A1: W
1235,99		17241,43
2-Block A: Roof ins.Block A1: Walls ins., Changing windows, Sh		3-Block A: Walls ins., Changing
3441,66	14409,94	238849,27
6731,30	28183,4	467148,57
2417,39		33721,3

6	7	8
S2:Walls	S2:Roof	S3:Building
Building assemblies ('U-Value')	Building assemblies ('U-Value')	Complete building
01ud Block A - plaster	10ud Roof type 2 direct to exter	- No additional input
2-Block A: Roof ins.Block A1: Walls ins., Changing windows, Sh		3-Block A: Walls ins., Changing
13877,02	3364,40	0,00
3-Block A: Walls ins., Changing windows, shading Block A1: Ro		4-New heat source, new DHW sy
55439,74	8547,21	6249,35
108430,7	16716,88	12222,66
27141,1	6580,2	

9	10
Compl.Building	S4:Building
Complete building	Complete building
- No additional input	- No additional input
1-No measures	4-New heat source, new DHW system
0,00	0,00
5-Basement insulation + LED Li	5-Basement insulation + LED Lighting
298746,16	12378,38
584296,71	24210

EnerPHit planning: **CLIMATE DATA**

Building: School "Tzanko Diustabanov"-Block A

Climate Building: Велико Търнов PHI

Monthly Data: User data - Велико Търнов PHI

Annual Data:

Use Annual Climate Data Set: no

Results:

Region: User Data

Climate data set: User data - Велико Търнов PHI

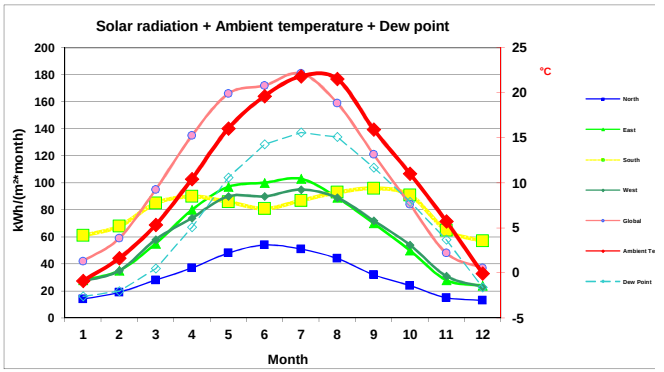
Weather station (altitude): 137,0 m

Building location (height above sea level): 382 m

Annual heating demand	250,1	kWh/(m²a)
Heating load	105,1	W/m²
Primary Energy	312,4	kWh/(m²a)

Transfer to annual method (Annual Heating)

H_T	189	d/a
G_t	74	kKh/a
North	122	kWh/(m²a)
East	240	kWh/(m²a)
South	432	kWh/(m²a)
West	243	kWh/(m²a)
Horizontal	400	kWh/(m²a)



Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating load		Cooling
Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2	Weather 1
Parameters for PHPP Calculated Ground Temperatures:	User data - Велико Търнов PHI	Latitude:	43,1	Longitude °	25,7	Altitude m	137	Daily Temperature Swing Summer (K)			11,2	Radiation Data:	kWh/(m²month)	Radiation: W/m²		Radiatio
Phase shift months	Ambient Temp	-0,9	1,6	5,3	10,4	16,0	19,6	21,8	21,5	15,9	11,0	5,7	-0,1	-9,1	-4,6	28,1
0,60	North	14	19	28	37	48	54	51	44	32	24	15	13	19	16	92
Damping	East	28	35	55	80	97	100	103	89	70	50	28	24	39	23	197
-0,31	South	61	68	85	90	86	81	87	93	96	91	65	57	82	40	185
Depth m	West	27	35	58	74	90	90	95	89	72	54	31	23	35	24	197
1,00	Global	42	59	95	135	166	172	181	159	121	84	48	37	56	36	349
User data - Example	Dew Point	-2,6	-2,0	0,5	5,1	10,6	14,3	15,6	15,1	11,7	7,9	3,7	-1,6			18,6
1,00	Sky Temp	-11,1	-9,3	-6,3	-1,1	5,3	9,4	11,4	10,9	6,3	1,9	-2,6	-9,3			16,5
	Ground Temp	17,7	17,6	17,8	18,0	18,4	18,8	23,1	19,2	19,0	18,8	18,4	18,0	17,6	17,6	23,2

Building: School "Tzanko Diustabanov"-Block A

Wedge-shaped building assemblies (tapered insulation), unventilated air layers and unheated attics

-> Auxiliary calculation to the right

Assembly No. 01ud | Building assembly description: Block A - plaster | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,13 | exterior R_{se} : 0,04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Bricks	0,790					400
3.	Plaster outside	0,870					30
4.	EPS-F	0,000					0
5.	Plaster	0,000					0
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 45,0 cm

U-value supplement W/(m²K) | **U-Value:** 1,347 W/(m²K)

Assembly No. 02ud | Building assembly description: Block A - stone façade | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,13 | exterior R_{se} : 0,04

	Area section 2	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Bricks	0,790					400
3.	Plaster outside	0,870					20
4.	Stone facede	1,060					40
5.	EPS-F	0,000					0
6.	Stone facede	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 48,0 cm

U-value supplement W/(m²K) | **U-Value:** 1,306 W/(m²K)

Assembly No. 03ud | Building assembly description: Ground walls | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,13 | exterior R_{se} :

	Area section 3	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Bitum	0,170					5
2.	Concrete	1,630					550
3.	Inside plaster	0,700					20
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 57,5 cm

U-value supplement W/(m²K) | **U-Value:** 1,903 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
04ud	Ground walls (heated basement)	

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} :

	Area section 4	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Bitum	0,170					5
2.	Concrete	1,630					200
3.	Inside plaster	0,700					20
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 22,5 cm

U-value supplement: W/(m²K) **U-Value:** 3,219 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
05ud	Floor (heated basement)	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} : 0,17

	Area section 5	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Mosaic	3,490					20
2.	Cement	0,930					30
3.	Concrete	2,100					200
4.	Stone embankment	3,500					250
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 50,0 cm

U-value supplement: W/(m²K) **U-Value:** 1,836 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
06ud	Floor (unheated basement)	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} : 0,17

	Area section 6	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Mosaic	3,490					20
2.	Cement	0,930					30
3.	Concrete	1,450					200
4.	Plaster	0,700					30
5.	EPS-F	0,000					0
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 28,0 cm

U-value supplement: W/(m²K) **U-Value:** 1,790 W/(m²K)

Assembly No. | Building assembly description | Interior insulation?

07ud | Floor slab on grade (mosaic)

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 7	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Mosaic	3,490					20
2.	Cement	0,930					50
3.	Concrete	1,450					150
4.	Stone embankment	3,500					300
5.	Floor insulation	0,000					0
6.	New flooring	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 52,0 cm

U-value supplement W/(m²K) **U-Value:** 2,389 W/(m²K)

Assembly No. | Building assembly description | Interior insulation?

08ud | Floor slab on grade (wood flooring)

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 8	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Wood	0,350					20
2.	Cement	0,930					30
3.	Concrete	1,450					200
4.	Stone embankment	3,500					250
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 50,0 cm

U-value supplement W/(m²K) **U-Value:** 2,133 W/(m²K)

Assembly No. | Building assembly description | Interior insulation?

09ud | Roof type 1 - unheated attic

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,10

	Area section 9	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Suspended ceiling	0,210					8
2.	Closed air	0,920					150
3.	Concrete	2,100					120
4.	Mineral wool	0,041					100
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 37,8 cm

U-value supplement W/(m²K) **U-Value:** 0,345 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
10ud	Roof type 2 direct to external air	

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 10	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster	0,700					20
2.	Concrete	2,100					200
3.	Cement	0,930					30
4.	Bitum	0,170					5
5.	XPS	0,000					0
6.	Hydroinsulation	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 25,5 cm

U-value supplement: W/(m²K) **U-Value:** 3,072 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
11ud	Block A - connection	

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} : 0,04

	Area section 11	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Bricks	0,790					500
3.	Plaster outside	0,870					30
4.	EPS-F	0,000					0
5.	Plaster	0,000					0
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 55,0 cm

U-value supplement: W/(m²K) **U-Value:** 1,155 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
12ud	Under unheated basement floor	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 12	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Cement	0,930					20
2.	Concrete	1,450					150
3.	Stone embankment	3,500					250
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 42,0 cm

U-value supplement: W/(m²K) **U-Value:** 2,729 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
13ud	Block A - stone façade	yes

Heat transfer resistance [m²K/W] interior Rsi : 0,13

exterior R_{se} : 0,04

	Area section 13	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Bricks	0,790					500
3.	Plaster outside	0,870					20
4.	Stone facede	1,060					40
5.	EPS-F	0,000					0
6.	Plaster	0,000					0
7.							
8.							
		Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3	Total
		100%					58,0 cm

U-value supplement W/(m²K) **U-Value:** 1,121 W/(m²K)

Assembly No. 14ud | Building assembly description: Block A connection roof direct to external air | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 14	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster	0,700					20
2.	Concrete	1,630					200
3.	Cement	0,930					30
4.	Bitum	0,170					5
5.	XPS	0,000					0
6.	Armed_cement	0,000					0
7.	Bitum	0,000					0
8.							
		Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3	Total
		100%					25,5 cm

U-value supplement W/(m²K) **U-Value:** 2,833 W/(m²K)

Assembly No. 15ud | Building assembly description: Roof type 2 direct to external air Connection | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 15	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster	0,700					20
2.	Concrete	2,100					200
3.	Cement	0,930					30
4.	Bitum	0,170					5
5.	Mineral wool	0,000					0
6.	Hydroinsulation	0,000					0
7.							
8.							
		Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3	Total
		100%					25,5 cm

U-value supplement W/(m²K) **U-Value:** 3,072 W/(m²K)

Assembly No. 16ud | Building assembly description: | Interior insulation?

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

	Area section 16	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness	50	mm	Convective heat transfer	
Direction of the thermal flow:	x	Upwards	h_a	1,95 W/(m²K)
		Horizontal	Radiation heat transfer	
		Downwards	h_r	4,17 W/(m²K)
Emissivity of surface 1	0,90		equivalent thermal conductivity	
Emissivity of surface 2	0,90		λ	**0,31** W/(mK)

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness		mm	Convective heat transfer	
of the		Upwards	h_a	W/(m²K)
		Horizontal	Radiation heat transfer	
		Downwards	h_r	W/(m²K)
Emissivity of surface 1			equivalent thermal conductivity	
Emissivity of surface 3			λ	W/(mK)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No.	Building assembly description
1a	Exemplary flat roof with wedge-shaped insulation

Heat transfer resistance [m²K/W]

interior Rsi :	0,10
exterior R_{se} :	0,04

A parallel assemblies layer

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Total Width Thickness d_0 [mm]
1.	Concrete Ceiling	2,100					160
2.	PS Rigid Foam	0,040					200
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			36,0 cm

U_0:	0,192	W/(m²K)
R_0:	5,216	(m²K)/W

B Wedge-Shaped Assembly Layer

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]
PS rigid foam insulation	0,040					150

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		15,0 cm

U_1:	0,267	W/(m²K)
R_1:	3,750	(m²K)/W
Rectangular Area U-Value:	**0,144**	W/(m²K)
U-value of triangular area with the thickest point at the apex:	**0,157**	W/(m²K)
U-value of triangular area with the thinnest point at the apex:	**0,131**	W/(m²K)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No. | Building assembly description

2a

Heat transfer resistance [m²K/W] interior Rsi :

exterior R_{se} :

A parallel assemblies layer

Total Width

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_0 [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

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

U_0: W/(m²K)

R_0: (m²K)/W

B Wedge-Shaped Assembly Layer

		Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		cm

U_1: W/(m²K)

R_1: (m²K)/W

Rectangular Area U-Value: W/(m²K)

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

U-value of triangular area with the thinnest point at the apex: W/(m²K)

Non-conditioned attic

Building assembly description

Roof

Heat transfer resistance [m²K/W] interior Rsi : 0,17 Exterior absorption coefficient **0,80**

exterior R_{se} : 0,04 Exterior emissivity **0,93**

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Corrugated galvanised iro	60,000					3
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			0,3 cm

U-value supplement W/(m²K) **U-Value:** **4,761** W/(m²K)

Building assembly description

Exterior attic wall

Heat transfer resistance [m²K/W] interior Rsi : 0,13 Exterior absorption coefficient 0,80

exterior R_{se} : 0,04 Exterior emissivity 0,93

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Interior plaster	0,350					15
2.	Masonry	1,100					175
3.	Exterior Render	0,800					20
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			21,0 cm

U-value supplement W/(m²K) **U-Value:** **2,519** W/(m²K)

Building assembly description

Intermediate ceiling

Heat transfer resistance [m²K/W] interior Rsi : 0,17

exterior R_{se} : 0,17

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Wooden floor	0,130					22
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
83%	16,7%		2,2 cm

U-value supplement W/(m²K)

U-Value: 1,964 W/(m²K)

Attic area

Roof area	200,0	m²
Area of exterior walls and attic	200,0	m²
Area of intermediate ceiling	100,0	m²

emissivity in the attic

Inner side of the roof / exterior wall	0,93
Upper side of the interior ceiling	0,93

Air exchange in the attic

Air change rate	0,20	1/h
Volume	200,0	m³

Equivalent value for the intermediate ceiling (to be linked to worksheets "Components" and "Areas"')

U-Value: 2,732 **Absorptivity: 0,780** **Emissivity: 0,907**

Total solar energy transmittance (informative): 0,085

EnerPHit planning: # AREAS DETERMINATION

Building: School "Tzanko Diustabanov"-Block A Heating demand 250 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment
1	Treated Floor Area		1303,46	m²	Treated floor area according to PHPP manual
2	North Windows	A	52,75	m²	Results come from the 'Windows' worksheet.
3	East Windows	A	242,41	m²	Window areas are subtracted from individual opaque areas.
4	South Windows	A	36,89	m²	which is displayed in the "Windows" worksheet.
5	West Windows	A	101,73	m²	
6	Horizontal Windows	A	0,00	m²	
7	Exterior Door	A	2,00	m²	Please subtract area of door from respective building assembly
8	Exterior Wall - Ambient	A	1365,61	m²	Temperature Zone "A" is ambient air.
9	Exterior Wall - Ground	B	0,00	m²	Temperature zone "B" is the ground.
10	Roof/Ceiling - Ambient	A	549,78	m²	
11	Floor slab / basement ceiling	B	549,78	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" — Factor for X
14		X	0,00	m²	Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1): 75%
15	Thermal Bridges Ambient	A	597,06	m	Units in m
16	Perimeter Thermal Bridges	P	110,20	m	Units in m; temperature zone "P" is perimeter (see Ground worksheet).
17	Thermal bridges FS/BC	B	0,00	m	Units in m
18	Partition Wall to Neighbour	I	70,07	m²	No heat losses, only considered for the heating load calculation.
Total thermal envelope			2900,94	m²	

Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
		10 months	12 months
North Windows	2,457	3006	4602
East Windows	2,384	26390	44325
South Windows	3,783	7765	8678
West Windows	2,389	11692	19607
Horizontal Windows			
Exterior Door	5,500		
Exterior Wall - Ambient	1,333	5880	9187
Exterior Wall - Ground			
Roof/Ceiling - Ambient	3,072	24117	34910
Floor slab / basement ceiling	2,012		
Thermal bridges - Overview	Ψ [W/(mK)]		
Thermal Bridges Ambient	-0,215		
Perimeter Thermal Bridges	-0,380		
Thermal bridges FS/BC			
Partition Wall to Neighbour	1,347		
Average Therm. Envelope	1,912		

Go to building components list

Area input

Sort: AS LIST

Area Nr.	Building assembly description	Group Nr.	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User-Determined [m²]	-	User Subtraction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection of building element assembly / certified building system	U-Value [W/(m²K)]	Deviation from North	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
	Treated floor area	1	Treated Floor Area	1	x (		x		+	1303,46	-				) =	1303,5									
	North Windows	2	North Windows													52,7	From 'Windows' worksheet	2,457						
	East Windows	3	East Windows													242,4	From 'Windows' worksheet	2,384						
	South Windows	4	South Windows			Please complete in Windows worksheet only!										36,9	From 'Windows' worksheet	3,783						
	West Windows	5	West Windows													101,7	From 'Windows' worksheet	2,389						
	Horizontal Windows	6	Horizontal Windows													0,0	From 'Windows' worksheet	0,000						
	Exterior Door	7	Exterior Door	1	x (	1,00	x	2,00	+		-		) -		=	2,0	U-value exterior door:	5,50						
1	Facade East 1	8	Exterior Wall - Ambient	1	x (	29,50	x	18,60	+		-		) -	154,3	=	394,4	01ud Block A - plaster	1,347	90	90	East	0,70	0,40	0,90
2	Facade East 2 - door	8	Exterior Wall - Ambient	1	x (	3,10	x	4,30	+		-		) -	0,0	=	13,3	11ud Block A - connection	1,155	90	90	East	0,70	0,40	0,90
3	Facade East 2 - door (st	8	Exterior Wall - Ambient	1	x (	3,10	x	0,60	+		-		) -	0,0	=	1,9	13ud Block A - stone façade	1,121	90	90	East	0,70	0,40	0,90
4	Facade North 1	8	Exterior Wall - Ambient	1	x (	9,50	x	18,10	+		-		) -	34,0	=	137,9	01ud Block A - plaster	1,347	0	90	North	0,70	0,40	0,90
5	Facade North 2	8	Exterior Wall - Ambient	1	x (	11,01	x	4,30	+		-		) -	18,7	=	28,6	11ud Block A - connection	1,155	0	90	North	0,70	0,40	0,90
6	Facade North 2 - stone	8	Exterior Wall - Ambient	1	x (	11,01	x	0,60	+		-		) -	0,0	=	6,6	13ud Block A - stone façade	1,121	0	90	North	0,70	0,40	0,90
7	Facade West 1	8	Exterior Wall - Ambient	1	x (	29,33	x	17,60	+		-	54,23	) -	101,7	=	360,3	01ud Block A - plaster	1,347	270	90	West	0,70	0,40	0,90
8	Facade West 2	18	Partition Wall to Neighbour	1	x (	14,30	x	4,90	+		-		) -	0,0	=	70,1	01ud Block A - plaster	1,347	270	90	West	0,70	0,40	0,90
9	Facade West 3 - door	8	Exterior Wall - Ambient	1	x (	3,10	x	4,30	+		-		) -	0,0	=	13,3	11ud Block A - connection	1,155	270	90	West	0,70	0,40	0,90
10	Facade West 3 - door (st	8	Exterior Wall - Ambient	1	x (	3,10	x	0,60	+		-		) -	0,0	=	1,9	13ud Block A - stone façade	1,121	270	90	West	0,70	0,40	0,90
11	Facade West 5	8	Exterior Wall - Ambient	1	x (	10,06	x	17,60	+		-		) -	0,0	=	177,1	01ud Block A - plaster	1,347	225	90	South	0,70	0,40	0,90
12	Façade South 1	8	Exterior Wall - Ambient	1	x (	3,05	x	4,30	+		-		) -	7,2	=	6,0	11ud Block A - connection	1,155	180	90	South	0,70	0,40	0,90
13	Façade South 1 - stone	8	Exterior Wall - Ambient	1	x (	3,05	x	0,60	+		-		) -	0,0	=	1,8	13ud Block A - stone façade	1,121	180	90	South	0,70	0,40	0,90
14	Façade South 2	8	Exterior Wall - Ambient	1	x (	5,08	x	4,30	+		-		) -	10,4	=	11,4	11ud Block A - connection	1,155	180	90	South	0,70	0,40	0,90
15	Façade South 2 - stone	8	Exterior Wall - Ambient	1	x (	5,08	x	0,60	+		-		) -	2,0	=	1,0	13ud Block A - stone façade	1,121	180	90	South	0,70	0,40	0,90
16	Façade South 3	8	Exterior Wall - Ambient	1	x (	6,08	x	4,30	+		-		) -	15,3	=	10,8	11ud Block A - connection	1,155	180	90	South	0,70	0,40	0,90
17	Façade South 3 - stone	8	Exterior Wall - Ambient	1	x (	6,08	x	0,60	+		-		) -	2,0	=	1,6	13ud Block A - stone façade	1,121	180	90	South	0,70	0,40	0,90
18	Façade South 4	8	Exterior Wall - Ambient	1	x (	12,08	x	18,70	+		-		) -	88,2	=	137,7	01ud Block A - plaster	1,347	135	90	East	0,70	0,40	0,90
19	Facade North 3	8	Exterior Wall - Ambient	1	x (	3,40	x	17,60	+		-		) -	0,0	=	59,8	01ud Block A - plaster	1,347	0	90	North	0,70	0,40	0,90
20	Floor block A	11	Floor slab / basement ceiling	1	x (		x		+	345,74	-		) -	0,0	=	345,7	06ud Floor (unheated basement)	1,790						
21	Floor block lobby	11	Floor slab / basement ceiling	1	x (		x		+	204,04	-		) -	0,0	=	204,0	07ud Floor slab on grade (mosaic)	2,389						
22	Roof block A	10	Roof/Ceiling - Ambient	1	x (		x		+	345,74	-		) -	0,0	=	345,7	10ud Roof type 2 direct to external a	3,072	0	0	Hor	0,40	0,95	0,90
23	Roof block lobby	10	Roof/Ceiling - Ambient	1	x (		x		+	204,04	-		) -	0,0	=	204,0	15ud Roof type 2 direct to external a	3,072	0	0	Hor	0,40	0,95	0,90
24					x (		x		+		-		) -	0,0	=									
25					x (		x		+		-		) -	0,0	=									
26					x (		x		+		-		) -	0,0	=									
27					x (		x		+		-		) -	0,0	=									

EnerPHit planning: **AREAS DETERMINATION**

Building: School "Tzanko Diustabanov"-Block A Heating demand 250 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment	Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	Treated Floor Area		1303,46	m²	*Treated floor area according to PHPP manual*			10 months	12 months
2	North Windows	A	52,75	m²	Results come from the 'Windows' worksheet.	North Windows	2,457	3006	4602
3	East Windows	A	242,41	m²	Window areas are subtracted from individual opaque areas.	East Windows	2,384	26390	44325
4	South Windows	A	36,89	m²	which is displayed in the "Windows" worksheet.	South Windows	3,783	7765	8678
5	West Windows	A	101,73	m²		West Windows	2,389	11692	19607
6	Horizontal Windows	A	0,00	m²		Horizontal Windows			
7	Exterior Door	A	2,00	m²	*Please subtract area of door from respective building assembly*	Exterior Door	5,500		
8	Exterior Wall - Ambient	A	1365,61	m²	*Temperature Zone "A" is ambient air.*	Exterior Wall - Ambient	1,333	5880	9187
9	Exterior Wall - Ground	B	0,00	m²	*Temperature zone "B" is the ground.*	Exterior Wall - Ground			
10	Roof/Ceiling - Ambient	A	549,78	m²		Roof/Ceiling - Ambient	3,072	24117	34910
11	Floor slab / basement ceiling	B	549,78	m²		Floor slab / basement ceiling	2,012		
12			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
13			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
14		X	0,00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):* 75%				
						Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	597,06	m	*Units in m*	Thermal Bridges Ambient	-0,215		
16	Perimeter Thermal Bridges	P	110,20	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*	Perimeter Thermal Bridges	-0,380		
17	Thermal bridges FS/BC	B	0,00	m	*Units in m*	Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	70,07	m²	*No heat losses, only considered for the heating load calculation.*	Partition Wall to Neighbour	1,347		
Total thermal envelope			2900,94	m²		Average Therm. Envelope	1,912		

Go to building components list

28					x (		x		+		-		) -	0,0	=									
29					x (		x		+		-		) -	0,0	=									
30					x (		x		+		-		) -	0,0	=									
31					x (		x		+		-		) -	0,0	=									
32					x (		x		+		-		) -	0,0	=									
33					x (		x		+		-		) -	0,0	=									
34					x (		x		+		-		) -	0,0	=									
35					x (		x		+		-		) -	0,0	=									
36					x (		x		+		-		) -	0,0	=									
37					x (		x		+		-		) -	0,0	=									
38					x (		x		+		-		) -	0,0	=									
39					x (		x		+		-		) -	0,0	=									
40					x (		x		+		-		) -	0,0	=									
41					x (		x		+		-		) -	0,0	=									
42					x (		x		+		-		) -	0,0	=									
43					x (		x		+		-		) -	0,0	=									
44					x (		x		+		-		) -	0,0	=									
45					x (		x		+		-		) -	0,0	=									
46					x (		x		+		-		) -	0,0	=									
47					x (		x		+		-		) -	0,0	=									
48					x (		x		+		-		) -	0,0	=									
49					x (		x		+		-		) -	0,0	=									
50					x (		x		+		-		) -	0,0	=									

Aend

EnerPHit planning: # AREAS DETERMINATION

Building: School "Tzanko Diustabanov"-Block A Heating demand 250 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment	Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	Treated Floor Area		1303,46	m²	*Treated floor area according to PHPP manual*			10 months	12 months
2	North Windows	A	52,75	m²	Results come from the 'Windows' worksheet.	North Windows	2,457	3006	4602
3	East Windows	A	242,41	m²	Window areas are subtracted from individual opaque areas.	East Windows	2,384	26390	44325
4	South Windows	A	36,89	m²	which is displayed in the "Windows" worksheet.	South Windows	3,783	7765	8678
5	West Windows	A	101,73	m²		West Windows	2,389	11692	19607
6	Horizontal Windows	A	0,00	m²		Horizontal Windows			
7	Exterior Door	A	2,00	m²	*Please subtract area of door from respective building assembly*	Exterior Door	5,500		
8	Exterior Wall - Ambient	A	1365,61	m²	*Temperature Zone "A" is ambient air.*	Exterior Wall - Ambient	1,333	5880	9187
9	Exterior Wall - Ground	B	0,00	m²	*Temperature zone "B" is the ground.*	Exterior Wall - Ground			
10	Roof/Ceiling - Ambient	A	549,78	m²		Roof/Ceiling - Ambient	3,072	24117	34910
11	Floor slab / basement ceiling	B	549,78	m²		Floor slab / basement ceiling	2,012		
12			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
13			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
14		X	0,00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):* 75%				
						Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	597,06	m	*Units in m*	Thermal Bridges Ambient	-0,215		
16	Perimeter Thermal Bridges	P	110,20	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*	Perimeter Thermal Bridges	-0,380		
17	Thermal bridges FS/BC	B	0,00	m	*Units in m*	Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	70,07	m²	*No heat losses, only considered for the heating load calculation.*	Partition Wall to Neighbour	1,347		
Total thermal envelope			2900,94	m²		Average Therm. Envelope	1,912		

Go to building components list

Thermal Bridge Inputs

Nr.	Thermal bridge description	Group Nr.	Assigned to group	Quantity	x (	User determined length [m]	-	Subtraction user-determined length [m]	)=	Length ℓ [m]	Input of thermal bridge heat loss coefficient W/(mK)	Ψ W/(mK)
1	Roof perimeter	15	Thermal Bridges Ambient	1	x (	93,78	-		) =	93,78	Roof perimeter	-1,207
2	Roof perimeter connectio	15	Thermal Bridges Ambient	1	x (	25,40	-		) =	25,40	Roof perimeter connection	-0,955
3	Basement perimeter	16	Perimeter Thermal Bridges	1	x (	58,68	-		) =	58,68	Basement perimeter	-0,767
4	Basement perimeter - win	16	Perimeter Thermal Bridges	1	x (	20,10	-		) =	20,10	Basement perimeter - windows	0,108
5	Basement ceiling correct	16	Perimeter Thermal Bridges	1	x (	31,42	-		) =	31,42	Basement ceiling correction	0,032
6	Roof to wall connection	15	Thermal Bridges Ambient	1	x (	20,38	-		) =	20,38	Roof to wall connection	0,431
7	Windows blinds	15	Thermal Bridges Ambient	1	x (	228,75	-		) =	228,75	Windows blinds	
8	Windows to walls	15	Thermal Bridges Ambient	1	x (	228,75	-		) =	228,75	Windows to walls	
9					x (		-		) =			
10					x (		-		) =			
11					x (		-		) =			
12					x (		-		) =			
13					x (		-		) =			
14					x (		-		) =			
15					x (		-		) =			
16					x (		-		) =			
17					x (		-		) =			
18					x (		-		) =			
19					x (		-		) =			
20					x (		-		) =			
21					x (		-		) =			
22					x (		-		) =			
23					x (		-		) =			
24					x (		-		) =			
25					x (		-		) =			
26					x (		-		) =			
27					x (		-		) =			
28					x (		-		) =			
29					x (		-		) =			
30					x (		-		) =			
31					x (		-		) =			

EnerPHit planning: **AREAS DETERMINATION**

Building: School "Tzanko Diustabanov"-Block A Heating demand 250 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment	Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	**Treated Floor Area**		**1303,46**	m²	*Treated floor area according to PHPP manual*			10 months	12 months
2	**North Windows**	A	**52,75**	m²	Results come from the 'Windows' worksheet. Window areas are subtracted from individual opaque areas. which is displayed in the "Windows" worksheet.	**North Windows**	**2,457**	**3006**	**4602**
3	**East Windows**	A	**242,41**	m²		**East Windows**	**2,384**	**26390**	**44325**
4	**South Windows**	A	**36,89**	m²		**South Windows**	**3,783**	**7765**	**8678**
5	**West Windows**	A	**101,73**	m²		**West Windows**	**2,389**	**11692**	**19607**
6	**Horizontal Windows**	A	**0,00**	m²		**Horizontal Windows**			
7	**Exterior Door**	A	**2,00**	m²	*Please subtract area of door from respective building assembly*	**Exterior Door**	**5,500**		
8	**Exterior Wall - Ambient**	A	**1365,61**	m²	*Temperature Zone "A" is ambient air.*	**Exterior Wall - Ambient**	**1,333**	**5880**	**9187**
9	**Exterior Wall - Ground**	B	**0,00**	m²	*Temperature zone "B" is the ground.*	**Exterior Wall - Ground**			
10	**Roof/Ceiling - Ambient**	A	**549,78**	m²		**Roof/Ceiling - Ambient**	**3,072**	**24117**	**34910**
11	**Floor slab / basement ceiling**	B	**549,78**	m²		**Floor slab / basement ceiling**	**2,012**		
12			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
13			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
14		X	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):* **75%**				
						Thermal bridges - Overview	**Ψ [W/(mK)]**		
15	**Thermal Bridges Ambient**	A	**597,06**	m	*Units in m*	**Thermal Bridges Ambient**	**-0,215**		
16	**Perimeter Thermal Bridges**	P	**110,20**	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*	**Perimeter Thermal Bridges**	**-0,380**		
17	**Thermal bridges FS/BC**	B	**0,00**	m	*Units in m*	**Thermal bridges FS/BC**			
18	**Partition Wall to Neighbour**	I	**70,07**	m²	*No heat losses, only considered for the heating load calculation.*	**Partition Wall to Neighbour**	1,347		
Total thermal envelope			**2900,94**	**m²**		**Average Therm. Envelope**	**1,912**		

Go to building components list

32					x (		-		) =				
33					x (		-		) =				
34					x (		-		) =				
35					x (		-		) =				
36					x (		-		) =				
37					x (		-		) =				
38					x (		-		) =				
39					x (		-		) =				
40					x (		-		) =				
41					x (		-		) =				
42					x (		-		) =				
43					x (		-		) =				
44					x (		-		) =				
45					x (		-		) =				
46					x (		-		) =				
47					x (		-		) =				
48					x (		-		) =				
49					x (		-		) =				
50					x (		-		) =				

TBend

A tool for thermal bridge conversion to exterior dimensions					
Description		Units	Window under	Windows above	
	Ψ Interior Dimensions	W/(mK)	0,110	0,103	
	Temperature Diff. TB	K	20,000	20,000	
Adjacent Aarea I	Temperature Diff. Δϑ I	K	20,000	20,000	
	Exterior - Interior Dim. I	m	0,050	0,020	
	U-Value building assembly I	W/(m²K)	0,790	0,790	
Adjacent Area II	Temperature Diff. Δϑ II	K	20,000	20,000	
	Exterior - Interior Dim. II	m	0,390	0,370	
	U-Value building assembly II	W/(m²K)	0,120	0,120	
	Ψ Exterior Dimensions	W/(mK)	0,024	0,043	

EnerPHit planning:

HEAT LOSSES THROUGH THE GROUND

Building part 1

Ground characteristics			
Thermal conductivity	λ	2,0	W/(mK)
Heat capacity	ρc	2,0	MJ/(m³K)
Periodic Penetration Depth	δ	3,17	m

Climate data			
Av. Indoor Temp. Winter	T_i	20,0	°C
Av. Indoor Temp. Summer	T_i	25,0	°C
Average Ground Surface Temperature	$T_{g,ave}$	11,7	°C
Amplitude of $T_{g,ave}$	$T_{g,\wedge}$	11,4	°C
Phase shifting of $T_{e,m}$	τ	1,0	Months
Length of the Heating Period	n	6,2	Months
Heating Degree Hours - Exterior	G_t	74,4	kKh/a

Building data							
Area of ground floor slab / basement ceiling	A	549,8	m²	U-value floor slab/basement ceiling	U_f	2,012	W/(m²K)
Perimeter length	P	125,2	m	Thermal bridges floor slab/basement ceiling	Ψ_B*l	0,00	W/K
Charact. Dimension of floor slab	B'	8,78	m	U-value floor slab / basement ceiling incl. TB	U_f'	2,012	W/(m²K)
				Eq. Thickness Floor	d_t	0,99	m

Floor Slab Type (select only one)

x **Slab on Grade**

Perimeter Insulation Width/Depth	D	0,30	m	Orientation of the Perimeter Ins.		horizontal	
Perimeter Insulation Thickness	d_n	0,20	m	(check only one field)		vertical	x
Conductivity perimeter insulation	λ_n	0,033	W/(mK)				

Heated basement or floor slab completely / partially below ground level

Basement wall height below ground level	z		m	U-Value below ground wall	U_{wB}		W/(m²K)

Unheated basement

Height aboveground wall	h	1,25	m	U-Value above ground wall	U_W	1,306	W/(m²K)
Basement wall height below ground level	z	1,40	m	U-Value below ground wall	U_{wB}	1,903	W/(m²K)
Air Change Unheated Basement	n	0,20	h^{-1}	U-Value Basement Floor Slab	U_{fB}	2,729	W/(m²K)
Air flow basement	V	770	m³				

Suspended Floor Above a Ventilated Crawl Space (at max. 0.5 m Below Ground)

U-Value Crawl Space	U_{Crawl}		W/(m²K)	Area of Ventilation Openings	εP		m²
Height of crawl space wall	h		m	Wind Velocity at 10 m Height	v	4,0	m/s
U-Value crawl space wall	U_W		W/(m²K)	Wind Shield factor	f_W	0,05	-

Additional Thermal Bridge Heat Losses at Perimeter							
				Steady-State Fraction	$\Psi_{P,stat}$*l	-41,831	W/K
Phase shift	β		Months	Harmonic Fraction	$\Psi_{P,harm}$*l	-41,831	W/K

Groundwater correction							
Depth of the Groundwater Table	z_w	3,0	m	Groundwater Correction Factor	G_w	1,09558193	-
Groundwater flow rate	q_w	0,05	m/d				

Interim Results

Phase shift	β	0,90	Months	Steady-state heat flow	Φ_{stat}	1701,4	W
Steady-state transmittance	L_S	204,49	W/K	Periodic Heat Flow	Φ_{harm}	443,3	W
Exterior Periodic transmittance	L_{pe}	71,46	W/K	Heat Losses During Heating Period	Q_{tot}	9737	kWh
Transmittance building	L_0	1064,28	W/K				

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

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	17,7	17,6	17,8	18,0	18,4	18,8	19,1	19,2	19,0	18,8	18,4	18,0	18,4
Summer	21,8	21,7	21,8	22,1	22,5	22,8	23,1	23,2	23,1	22,8	22,4	22,0	22,4

Design ground temperature for 'Heating load' worksheet 17,6 **For 'Cooling load' worksheet** 23,2

Reduction factor for 'Annual heating' worksheet 0,12

Total result (all building parts)

Phase shift	β	0,90	Months	Steady-state heat flow	Φ_{stat}	1701,4	W
Steady-state transmittance	L_S	204,49	W/K	Periodic Heat Flow	Φ_{harm}	443,3	W
Exterior Periodic transmittance	L_{pe}	71,46	W/K	Heat Losses During Heating Period	Q_{tot}	9737	kWh
Transmittance building	L_0	1064,28	W/K	Charact. Dimension of floor slab	B'	8,78	m

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

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	17,7	17,6	17,8	18,0	18,4	18,8	19,1	19,2	19,0	18,8	18,4	18,0	18,4
Summer	21,8	21,7	21,8	22,1	22,5	22,8	23,1	23,2	23,1	22,8	22,4	22,0	22,4

Design ground temperature for 'Heating load' worksheet 17,6 **For 'Cooling load' worksheet** 23,2

Reduction factor for 'Annual heating' worksheet 0,12

Go to: 'AREAS'
Glazing
Window frame
http://www.passiv.de/komponentendatenbank/en-EN
Ventilation units
Compact units

Building assemblies (U-values)

		1			
ID	**Building system**	**Building assembly**	**Total thickness**	**U-Value**	**Interior insulation**
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
01ud	Block A - plaster	Block A - plaster	0,450	1,347	
02ud	Block A - stone façade	Block A - stone façade	0,480	1,306	
03ud	Ground walls	Ground walls	0,575	1,903	
04ud	Ground walls (heated basement)	Ground walls (heated basement)	0,225	3,219	
05ud	Floor (heated basement)	Floor (heated basement)	0,500	1,836	
06ud	Floor (unheated basement)	Floor (unheated basement)	0,280	1,790	
07ud	Floor slab on grade (mosaic)	Floor slab on grade (mosaic)	0,520	2,389	
08ud	Floor slab on grade (wood flooring)	Floor slab on grade (wood flooring)	0,500	2,133	
09ud	Roof type 1 - unheated attic	Roof type 1 - unheated attic	0,378	0,345	
10ud	Roof type 2 direct to external air	Roof type 2 direct to external air	0,255	3,072	
11ud	Block A - connection	Block A - connection	0,550	1,155	
12ud	Under unheated basement floor	Under unheated basement floor	0,420	2,729	
13ud	Block A - stone façade	Block A - stone façade	0,580	1,121	yes
14ud	Block A connection roof direct to exter	Block A connection roof direct to exter	0,255	2,833	
15ud	Roof type 2 direct to external air Conn	Roof type 2 direct to external air Conn	0,255	3,072	
16ud					
17ud					
18ud					
19ud					
20ud					
21ud					
22ud					
23ud					
24ud					
25ud					
26ud					
27ud					
28ud					
29ud					
30ud					
31ud					
32ud					
33ud					
34ud					
35ud					
36ud					
37ud					
38ud					
39ud					
40ud					
41ud					
42ud					
43ud					
44ud					
45ud					

Building assemblies (U-values)

		1			
ID	Building system	Building assembly	Total thickness	U-Value	Interior insulation
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
46ud					
47ud					
48ud					
49ud					
50ud					
51ud					
52ud					
53ud					
54ud					
55ud					
56ud					
57ud					
58ud					
59ud					
60ud					
61ud					
62ud					
63ud					
64ud					
65ud					
66ud					
67ud					
68ud					
69ud					
70ud					
71ud					
72ud					
73ud					
74ud					
75ud					
76ud					
77ud					
78ud					
79ud					
80ud					
81ud					
82ud					
83ud					
84ud					
85ud					
86ud					
87ud					
88ud					
89ud					
90ud					
91ud					
92ud					
93ud	Brickwork 24 years old	Brickwork 24 years old	0,275	1,440	
94ud	Solid Brick 38-old	Solid Brick 38-old	0,415	1,640	
95ud	Half timbered 18-old	Half timbered 18-old	0,210	1,800	
96ud	Brickwork 30 years old	Brickwork 30 years old	0,335	1,230	

Building assemblies (U-values)

		1			
ID	Building system	Building assembly	Total thickness	U-Value	Interior insulation
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
97ud	Precast concrete-old	Precast concrete-old	0,275	1,300	
98ud	Wooden joist ceiling-old	Wooden joist ceiling-old	0,284	0,990	
99ud	Basement ceiling-old	Basement ceiling-old	0,242	1,230	

Glazing

Glazing

ID	Description	g-Value	U_g-Value
			W/(m²K)
01ud	44 mm. triple glazing, 2 Low-E, air, alum.spacer	0,51	0,70
02ud			
03ud			
04ud			
05ud			
06ud			
07ud			
08ud			
09ud			
10ud			
11ud			
12ud			
13ud			
14ud			
15ud			
16ud			
17ud			
18ud			
19ud			
20ud			
21ud			
22ud			
23ud			
24ud			
25ud			
26ud			
27ud			
28ud			
29ud			
30ud			
31ud			
32ud			
33ud			
34ud			
35ud			
36ud			
37ud			
38ud			
39ud			
40ud			
41ud			
42ud			
43ud			
44ud			
45ud			
46ud			
47ud			
48ud			
49ud			
50ud			
51ud			

Glazing			Glazing
ID	Description	g-Value	U_g-Value
			W/(m²K)
52ud			
53ud			
54ud			
55ud			
56ud			
57ud			
58ud			
59ud			
60ud			
61ud			
62ud			
63ud			
64ud			
65ud			
66ud			
67ud			
68ud			
69ud			
70ud			
71ud			
72ud			
73ud			
74ud			
75ud			
76ud			
77ud			
78ud			
79ud			
80ud			
81ud			
82ud			
83ud			
84ud			
85ud			
86ud			
87ud			
88ud			
89ud			
90ud			
91ud			
92ud	**Single glazing**	**0,87**	**5,80**
93ud	**Double glazing 4/12mm air/4**	**0,77**	**2,90**
94ud	**Double glazing 4/16mm air/4**	**0,77**	**2,70**
95ud	**Double glazing 4/20mm air/4**	**0,77**	**2,80**
96ud	**Double glazing 4/25mm air/4**	**0,77**	**2,80**
97ud	**Double glazing 4/30mm air/4**	**0,77**	**2,80**
98ud	**Triple glazing 4/10 air/4/10 air/4**	**0,70**	**2,00**
99ud	**Double low-e 4/16Argon90%/4 Epsilon=0.1**	**0,64**	**1,30**

Window frames

Window frames

		U_f-Value				Frame Width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
ID	Description	left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge}$ left	$\Psi_{Glazing\ edge}$ right	$\Psi_{Glazing\ edge}$ bottom	$\Psi_{Glazing\ edge}$ top	$\Psi_{Installation}$ left	$\Psi_{Installation}$ right	$\Psi_{Installation}$ bottom	$\Psi_{Installation}$ top	χ_{GC} -value Glass carrier
		W/(m²K)	W/(m²K)	W/(m²K)	W/(m²K)	m	m	m	m	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/K
01ud																		
02ud																		
03ud																		
04ud																		
05ud																		
06ud																		
07ud																		
08ud																		
09ud																		
10ud																		
11ud																		
12ud																		
13ud																		
14ud																		
15ud																		
16ud																		
17ud																		
18ud																		
19ud																		
20ud																		
21ud																		
22ud																		
23ud																		
24ud																		
25ud																		
26ud																		
27ud																		
28ud																		
29ud																		
30ud																		
31ud																		
32ud																		
33ud																		
34ud																		
35ud																		
36ud																		
37ud																		
38ud																		
39ud																		
40ud																		
41ud																		
42ud																		
43ud																		
44ud																		
45ud																		
46ud																		
47ud																		
48ud																		
49ud																		
50ud																		
51ud	**PH-FRAMES: average thermal quality**	**0,75**	**0,75**	**0,75**	**0,75**	**0,140**	**0,140**	**0,140**	**0,140**	**0,040**	**0,040**	**0,040**	**0,040**	**0,040**	**0,040**	**0,040**	**0,040**	

Window frames

		U_f-Value				Frame Width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
ID	Description	left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge\ left}$	$\Psi_{Glazing\ edge\ right}$	$\Psi_{Glazing\ edge\ bottom}$	$\Psi_{Glazing\ edge\ top}$	$\Psi_{Installation\ left}$	$\Psi_{Installation\ right}$	$\Psi_{Installation\ bottom}$	$\Psi_{Installation\ top}$	χ_{GC} -value Glass carrier
		W/(m²K)	W/(m²K)	W/(m²K)	W/(m²K)	m	m	m	m	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/K
52ud	PH-FRAMES: good thermal quality	0,72	0,72	0,72	0,72	0,140	0,140	0,140	0,140	0,035	0,035	0,035	0,035	0,040	0,040	0,040	0,040	
53ud	EXISTING: timber 45 mm	2,50	2,50	2,50	2,50	0,140	0,140	0,140	0,140	0,050	0,050	0,050	0,050	0,040	0,040	0,040	0,040	
54ud	EXISTING: timber 68 mm	1,60	1,60	1,60	1,60	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	
55ud	EXISTING: synthetic, good	1,60	1,60	1,60	1,60	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	
56ud	EXISTING: synthetic before 1998	1,80	1,80	1,80	1,80	0,140	0,140	0,140	0,140	0,050	0,050	0,050	0,050	0,040	0,040	0,040	0,040	
57ud	EXISTING: synthetic, before 1972	2,20	2,20	2,20	2,20	0,140	0,140	0,140	0,140	0,050	0,050	0,050	0,050	0,040	0,040	0,040	0,040	
58ud	EXISTING: metal, thermal break	2,40	2,40	2,40	2,40	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	
59ud	EXISTING: metal, no thermal break	4,50	4,50	4,50	4,50	0,140	0,140	0,140	0,140	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	
60ud	EXISTING: metal, no thermal break, paint finish	5,50	5,50	5,50	5,50	0,140	0,140	0,140	0,140	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	
61ud	INSTALLATION SITUATION: timber, not insulated, masonry, not ins													0,088				
62ud	INSTALLATION SITUATION: timber, not insulated, covered with 60													0,002				
63ud	INSTALLATION SITUATION: PVC, not insulated, masonry, not insula													0,088				
64ud	INSTALLATION SITUATION: PVC, not insulated,überdämmt mit WDVS 6													0,002				
65ud	INSTALLATION SITUATION: Metal, no thermal break, masonry wall,													0,088				
66ud	INSTALLATION SITUATION: insulated timber, EIFS, in insulation l													0,009				
67ud	INSTALLATION SITUATION: insulated timber, EIFS, partially on ma													0,021				
68ud	INSTALLATION SITUATION: insulated timber, EIFS, flush with the													0,076				
69ud	INSTALLATION SITUATION: insulated timber, lightweight wall (opt													0,009				
70ud	INSTALLATION SITUATION: insulated timber, insulated concrete fo													0,001				
71ud	INSTALLATION SITUATION: insulated PVC, EIFS, insulation layer													0,009				
72ud	INSTALLATION SITUATION: insulated PVC, EIFS, partially on mason													0,021				
73ud	INSTALLATION SITUATION: insulated PVC, EIFS, flush with the mas													0,076				
74ud	INSTALLATION SITUATION: insulated PVC, lightweight wall (optima													0,009				
75ud	INSTALLATION SITUATION: insulated PVC, insulated concrete formw													0,001				
76ud	INSTALLATION SITUATION: insulated timber-aluminium, EIFS, insul													0,013				
77ud	INSTALLATION SITUATION: insulated timber-aluminium, EIFS, parti													0,023				
78ud	INSTALLATION SITUATION: insulated timber-aluminium, lightweight													0,013				
79ud	INSTALLATION SITUATION: insulated timber-aluminium, insulated c													0,002				
80ud	INSTALLATION SITUATION: insulated timber-aluminium, insulated c													0,013				
81ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum													0,002				
82ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum													0,010				
83ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum													0,006				
84ud	INSTALLATION SITUATION: insulated timber-aluminium, short alum													0,013				
85ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, outside, in front of the facade													0,343				
86ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, flush with the facade on the outside													0,036				
87ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, in the insulation layer													0,034				
88ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, between insulation layer and wall													0,059				
89ud	INSTALLATION SITUATION MULLION-TRANSOM: timber, flush with the insulation layer on the inside													0,397				
90ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, outside, in front of the facade													0,666				
91ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, flush with the insulation layer on the outside													0,047				
92ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, in the insulation layer													0,044				
93ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, between insulation layer and wall													0,062				
94ud	INSTALLATION SITUATION MULLION-TRANSOM: steel, flush with the insulation layer on the inside													0,409				
95ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, outside, in front of the facade													0,747				
96ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, flush with the insulation layer on the outside													0,056				
97ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, in the insulation layer													0,053				
98ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, between insulation layer and wall													0,070				
99ud	INSTALLATION SITUATION MULLION-TRANSOM: Alum, flush with the insulation layer on the inside													0,421				

Ventilation units with heat recovery

Ventilation units with heat recovery

ID	Description	Heat recovery efficiency	Energy recovery value η_{FRG}	Electric efficiency	Additional Device Data: Entry area		External pressure per line	Fittings Δp_{intern}	Frost protection required	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
01ud	Tangra ventilation unit EVB 04 HiE	82%	0%	0,40	150	400	100	incl.	yes	–	57	57	
02ud	Tangra ventilation unit EVB 06 HiE	82%	0%	0,40	250	600	100	incl.	yes	–	61	61	
03ud	Tangra ventilation unit EVB 08 HiE	82%	0%	0,40	400	800			yes	–	61	61	
04ud	Tangra ventilation unit EVB 10 HiE	82%	0%	0,40	500	1000			yes	–	61	61	
05ud	Tangra ventilation unit EVB 12 HiE	82%	0%	0,40	750	1200			yes	–	68	68	
06ud	Tangra ventilation unit EVB 16 HiE	82%	0%	0,40	800	1600			yes	–	68	68	
07ud	Tangra ventilation unit EVB 20 HiE	82%	0%	0,40	1000	2000			yes	–	68	68	
08ud													
09ud													
10ud													
11ud													
12ud													
13ud													
14ud													
15ud													
16ud													
17ud													
18ud													
19ud													
20ud													
21ud													
22ud													
23ud													
24ud													
25ud													
26ud													
27ud													
28ud													
29ud													
30ud													
31ud													
32ud													
33ud													
34ud													
35ud													
36ud													
37ud													
38ud													
39ud													
40ud													
41ud													
42ud													
43ud													
44ud													
45ud													
46ud													
47ud													
48ud													
49ud													
50ud													
51ud													

Ventilation units with heat recovery

Ventilation units with heat recovery

ID	Description	Heat recovery efficiency	Energy recovery value η_{FRG}	Electric efficiency	Additional Device Data: Entry area		External pressure per line	Fittings Δp_{intern}	Frost protection required	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
52ud													
53ud													
54ud													
55ud													
56ud													
57ud													
58ud													
59ud													
60ud													
61ud													
62ud													
63ud													
64ud													
65ud													
66ud													
67ud													
68ud													
69ud													
70ud													
71ud													
72ud													
73ud													
74ud													
75ud													
76ud													
77ud													
78ud													
79ud													
80ud													
81ud													
82ud													
83ud													
84ud													
85ud													
86ud													
87ud													
88ud													
89ud													
90ud													
91ud													
92ud													
93ud													
94ud													
95ud													
96ud													
97ud	**Default**	**75%**		**0,45**									
98ud	**Extract air system**	**0%**		**0,25**									
99ud	Compact unit to be chosen from 'Compact' worksheet												

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: School "Tzanko Diustabanov"-Block A

Annual heating demand: 250 kWh/(m²a)

Heating degree hours: 74,4

Climate: User data - Велико Търнов PHI

Window area orientation	Global radiation (cardinal points)	Shading	Dirt	Non-perpendicular incident radiation	Glazing fraction	g-Value	Solar radiation reduction factor	Window area	Window U-Value	Glazing area	Average global radiation	Transmission losses	Heat gains solar radiation
maximum:	kWh/(m²a)	0,75	0,95	0,85				m²	W/(m²K)	m²	kWh/(m²a)	kWh/a	kWh/a
North	122	0,63	0,95	0,85	0,516	0,77	0,26	52,75	2,46	27,22	122	9639	1291
East	240	0,58	0,95	0,85	0,484	0,77	0,23	242,41	2,38	117,21	287	42982	12116
South	432	0,75	0,95	0,85	0,554	0,81	0,33	36,89	3,78	20,45	432	10382	4305
West	243	0,70	0,95	0,85	0,479	0,77	0,27	101,73	2,39	48,76	243	18078	5128
Horizontal	400	1,00	0,95	0,85	0,000	0,00	0,00	0,00	0,00	0,00	400	0	0
Total or Average Value for All Windows.						0,77	0,25	433,78	2,51	213,65		81081	22841

Go to glazing list Go to window frames list

Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Window rough openings: Width	Window rough openings: Height	installed in: Selection from worksheet 'Areas'	Glazing: Selection from worksheet 'Components'	Frame: Selection from worksheet 'Components'	g-Value: Perpendicular Radiation	U-Value: Glazing	U-Value: Frames (centre)	Ψ Glazing edge: Ψspacer (centre)	Installation situation: left	right	bottom	above	Ψinstallation (Average)	Results: Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Transmission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a
2	WC T1 Level 1	0	90	North	0,850	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	1	1	0,040	2,6	1,45	2,52	55%	493	41
2	WC T1 Level 2	0	90	North	0,850	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	1	1	0,040	2,6	1,45	2,52	55%	493	45
2	WC T1 Level 3	0	90	North	0,850	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	1	1	0,040	2,6	1,45	2,52	55%	493	50
2	WC T1 Level 4	0	90	North	0,850	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	1	1	0,040	2,6	1,45	2,52	55%	493	58
2	WC T1 Level 5	0	90	North	0,850	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	1	1	0,040	2,6	1,45	2,52	55%	493	72
18	Corridor T2	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	18,3	8,85	2,42	48%	3287	1046
18	no shading	270	90	West	0,750	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	19,6	9,90	2,38	51%	3469	1186
18		270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	18,3	8,85	2,42	48%	3287	1046
5	Corridor T2	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	5,1	2,46	2,42	48%	913	218
5	страничен екран от юг	270	90	West	0,750	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	5,4	2,75	2,38	51%	964	247
5		270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	5,1	2,46	2,42	48%	913	218
3	Corridor T2	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	3,0	1,47	2,42	48%	548	117
3	Shading 1fl.	270	90	West	0,750	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	3,3	1,65	2,38	51%	578	133
3	old building	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	3,0	1,47	2,42	48%	548	117
3	Corridor T2	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	3,0	1,47	2,42	48%	548	146
3	Shading 2fl.	270	90	West	0,750	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	3,3	1,65	2,38	51%	578	166
3	old building	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	3,0	1,47	2,42	48%	548	146
4	Classroom T3 sou	135	90	East	2,150	0,600	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	5,2	2,39	2,40	46%	920	185
4	Level 1	135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	4,1	1,97	2,39	48%	722	147
4		135	90	East	0,750	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	4,4	2,20	2,36	51%	762	167
4		135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	4,1	1,97	2,39	48%	722	147
4	Classroom T3 sou	135	90	East	2,150	0,600	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	5,2	2,39	2,40	46%	920	222
4	Level 2	135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	4,1	1,97	2,39	48%	722	176
4		135	90	East	0,750	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	4,4	2,20	2,36	51%	762	200
4		135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	4,1	1,97	2,39	48%	722	176
4	Classroom T3 sou	135	90	East	2,150	0,600	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	5,2	2,39	2,40	46%	920	267
4	Level 3	135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	4,1	1,97	2,39	48%	722	212
4		135	90	East	0,750	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	4,4	2,20	2,36	51%	762	241
4		135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	4,1	1,97	2,39	48%	722	212
4	Classroom T3 sou	135	90	East	2,150	0,600	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	5,2	2,39	2,40	46%	920	318
4	Level 4	135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	4,1	1,97	2,39	48%	722	252
4		135	90	East	0,750	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	4,4	2,20	2,36	51%	762	287
4		135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	4,1	1,97	2,39	48%	722	252
4	Classroom T3 sou	135	90	East	2,150	0,600	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	5,2	2,39	2,40	46%	920	414
4	Level 5	135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	4,1	1,97	2,39	48%	722	332
4		135	90	East	0,750	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	4,4	2,20	2,36	51%	762	375
4		135	90	East	0,700	1,450	18-Façade South 4	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	4,1	1,97	2,39	48%	722	332
25	Classroom T3 Eas	90	90	East	2,150	0,600	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	32,3	14,96	2,40	46%	5749	1574
25		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	25,4	12,29	2,39	48%	4513	1229
25		90	90	East	0,750	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	27,2	13,75	2,36	51%	4763	1403
25		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	25,4	12,29	2,39	48%	4513	1229
5	Classroom T3 Eas	90	90	East	2,150	0,600	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	6,5	2,99	2,40	46%	1150	362

					Window rough openings		installed in	Glazing	Frame	g-Value	U-Value		Ψ Glazing edge	Installation situation user-defined value for $\Psi_{installed}$ or '1': $\Psi_{installed}$ from worksheet 'Components' '0': in the case of abutting windows					Results U- and Ψ-values from 'Components' worksheet can be shown through clicking the '+' sign on the top edge of the sheet.					
Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from worksheet 'Areas'	Selection from worksheet 'Components'	Selection from worksheet 'Components'	Perpendicular Radiation	Glazing	Frames (centre)	Ψ_{spacer} (centre)	left	right	bottom	above	$\Psi_{installation}$ (Average)	Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Transmission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a
5		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	5,1	2,46	2,39	48%	903	288
5		90	90	East	0,750	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	5,4	2,75	2,36	51%	953	326
5		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	5,1	2,46	2,39	48%	903	288
5	Classroom T3 Eas	90	90	East	2,150	0,600	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	1	0	1	0,040	6,5	2,99	2,40	46%	1150	145
5		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	5,1	2,46	2,39	48%	903	115
5		90	90	East	0,750	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	5,4	2,75	2,36	51%	953	130
5		90	90	East	0,700	1,450	1-Facade East 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	0	0,040	5,1	2,46	2,39	48%	903	115
1	Steirs T4 Level	0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	1,2	0,66	2,46	53%	227	19
2		0	90	North	0,700	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	2,2	1,07	2,37	49%	382	31
1		0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	1,2	0,66	2,46	53%	227	19
1	Steirs T4 Level	0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	1,2	0,66	2,46	53%	227	21
2		0	90	North	0,700	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	2,2	1,07	2,37	49%	382	35
1		0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	1,2	0,66	2,46	53%	227	23
1	Steirs T4 Level	0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	1,2	0,66	2,46	53%	227	27
2		0	90	North	0,700	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	2,2	1,07	2,37	49%	382	44
1		0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	1,2	0,66	2,46	53%	227	28
1	Steirs T4 Level	0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	1,2	0,66	2,46	53%	227	33
2		0	90	North	0,700	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	2,2	1,07	2,37	49%	382	53
1		0	90	North	0,800	1,550	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	1,2	0,66	2,46	53%	227	34
1	Steirs T4 Level	0	90	North	0,800	0,750	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	0,6	0,24	2,38	41%	106	13
2		0	90	North	0,700	0,750	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	1,1	0,39	2,29	38%	179	21
1		0	90	North	0,800	0,750	4-Facade North 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	0,6	0,24	2,38	41%	106	13
1	Door T5 lev. 2	270	90	West	0,850	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	0	1	0,040	0,4	0,10	2,19	25%	62	3
1		270	90	West	1,050	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	0	1	0,040	0,5	0,13	2,18	28%	77	4
1		270	90	West	0,850	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	0	1	0,040	0,4	0,10	2,19	25%	62	3
3		270	90	West	0,425	0,560	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	0	0	0,040	0,7	0,12	2,04	17%	108	3
6		270	90	West	0,425	0,560	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	0	0	0,000	1,4	0,24	1,95	17%	207	6
1		270	90	West	1,050	1,700	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	0	0	0,000	1,8	1,09	2,43	61%	323	60
3		270	90	West	0,425	0,560	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	0	0	0,040	0,7	0,12	2,04	17%	108	3
1		270	90	West	0,850	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	0	0,040	0,4	0,10	2,19	25%	62	3
1		270	90	West	1,050	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	0	0,040	0,5	0,13	2,18	28%	77	4
1		270	90	West	0,850	0,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	0	0	0,040	0,4	0,10	2,11	25%	60	3
1	Corridor T7	270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	1	0	1	1	0,040	1,0	0,49	2,42	48%	183	58
2		270	90	West	0,750	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	0	1	1	0,040	2,2	1,10	2,38	51%	385	132
1		270	90	West	0,700	1,450	7-Facade West 1	97ud Double glazing 4/30mm air/4	54ud EXISTING: timber 68 mm	0,77	2,80	1,60	0,040	0	1	1	1	0,040	1,0	0,49	2,42	48%	183	58
3	Lobby T8	0	90	North	0,900	1,000	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	0	1	0,040	2,7	1,34	2,48	50%	498	85
3		0	90	North	0,600	1,000	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	0	1	0,040	1,8	0,69	2,36	38%	316	42
3		0	90	North	0,900	1,000	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	0	1	0,040	2,7	1,34	2,48	50%	498	85
3		0	90	North	0,900	1,600	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	1	0	0,040	4,3	2,46	2,52	57%	808	160
3		0	90	North	0,600	1,600	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	1	0	0,040	2,9	1,27	2,39	44%	512	79
3		0	90	North	0,900	1,600	5-Facade North 2	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	1	0	0,040	4,3	2,46	2,52	57%	808	160
1	Lobby T9	180	90	South	1,000	1,000	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	0	1	0,040	1,0	0,52	2,49	52%	185	122
1		180	90	South	0,750	1,000	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	0	1	0,040	0,8	0,34	2,40	45%	134	78
1		180	90	South	1,000	1,000	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	0	1	0,040	1,0	0,52	2,49	52%	185	122
1		180	90	South	1,000	1,600	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	1	0	0,040	1,6	0,95	2,53	59%	301	229
1		180	90	South	0,750	1,600	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	1	0	0,040	1,2	0,62	2,44	52%	218	146
1		180	90	South	1,000	1,600	12-Façade South 1	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	1	0	0,040	1,6	0,95	2,53	59%	301	229
2	Lobby Door T10	180	90	South	1,000	1,000	14-Façade South 2	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	1	0	0	1	0,040	2,0	1,04	5,82	52%	866	187
2		180	90	South	1,000	1,000	14-Façade South 2	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	0	1	0	1	0,040	2,0	1,04	5,82	52%	866	187
2		180	90	South	1,000	1,600	14-Façade South 2	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	1	0	0	0	0,040	3,2	1,90	5,79	59%	1379	476
2		180	90	South	1,000	1,600	14-Façade South 2	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	0	1	0	0	0,040	3,2	1,90	5,79	59%	1379	476
2	solid	180	90	South	1,000	1,000	15-Façade South 2 - stone	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	1	0	1	0	0,040	2,0	1,04	5,82	52%	866	0
2	solid	180	90	South	1,000	1,000	17-Façade South 3 - stone	92ud Single glazing	60ud EXISTING: metal, no thermal break, p	0,87	5,80	5,50	0,030	0	1	1	0	0,040	2,0	1,04	5,82	52%	866	0
1	Lobby T11	180	90	South	1,100	1,000	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	0	1	0,040	1,1	0,59	2,50	54%	205	140
2		180	90	South	0,750	1,000	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	0	1	0,040	1,5	0,68	2,40	45%	268	155
2		180	90	South	1,100	1,000	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	0	1	0,040	2,2	1,18	2,46	54%	403	280
1		180	90	South	1,100	1,000	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	0	1	0,040	1,1	0,59	2,50	54%	205	140
1		180	90	South	1,100	1,600	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	1	0	1	0	0,040	1,8	1,08	2,54	62%	332	262
2		180	90	South	0,750	1,600	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	1	0	0,040	2,4	1,24	2,44	52%	435	291
2		180	90	South	1,100	1,600	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	0	1	0	0,040	3,5	2,16	2,50	62%	655	524
1		180	90	South	1,100	1,600	16-Façade South 3	94ud Double glazing 4/16mm air/4	56ud EXISTING: synthetic before 1998	0,77	2,70	1,80	0,050	0	1	1	0	0,040	1,8	1,08	2,54	62%	332	262

					Window rough openings		installed in	Glazing	Frame	g-Value	U-Value		Ψ Glazing edge	Installation situation user-defined value for $\Psi_{installed}$ or '1': $\Psi_{installed}$ from worksheet 'Components' '0': in the case of abutting windows					Results U- and Ψ-values from 'Components' worksheet can be shown through clicking the '+' sign on the top edge of the sheet.					
Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from worksheet 'Areas'	Selection from worksheet 'Components'	Selection from worksheet 'Components'	Perpen-dicular Radiation	Glazing	Frames (centre)	Ψ_{spacer} (centre)	left	right	bottom	above	$\Psi_{installation}$ (Average)	Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Trans-mission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a

CALCULATING SHADING FACTORS

Climate: User data - Велико Търнов PHI

Building: School "Tzanko Diustabanov"-Block A

Latitude: 43,086 °

Orientation	Glazing area	Reduction factor winter	Summer reduction factor
	m²	r_S	r_S
North	27,22	63%	68%
East	117,21	58%	70%
South	20,45	75%	64%
West	48,76	70%	83%
Horizontal	0,00	100%	100%

Space heating demand:	250,1	kWh/(m²a)
Useful Cooling Demand:	10,3	kWh/(m²a)
Frequency of overheating:	9,6%	

								Horizon		Reveal		Overhang					Winter				Summer			
Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%	%	%	%	%	%	%
					w_G	h_G	A_G	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	$r_{other,w}$	$r_{other,s}$	z	r_H	r_R	r_O	r_S	r_H	r_R	r_O	r_S
2	WC T1 Level 1	0	90	North	0,57	1,27	1,4	18,00	11,00	0,15	0,120	0,15	0,12				44%	90%	95%	38%	52%	90%	98%	46%
2	WC T1 Level 2	0	90	North	0,57	1,27	1,4	14,40	11,00	0,15	0,12	0,15	0,12				48%	90%	95%	41%	55%	90%	98%	48%
2	WC T1 Level 3	0	90	North	0,57	1,27	1,4	10,80	11,00	0,15	0,120	0,15	0,12				54%	90%	95%	45%	59%	90%	98%	52%
2	WC T1 Level 4	0	90	North	0,57	1,27	1,4	7,20	11,00	0,15	0,120	0,15	0,12				63%	90%	95%	53%	66%	90%	98%	58%
2	WC T1 Level 5	0	90	North	0,57	1,27	1,4	3,60	11,00	0,15	0,120	0,15	0,12				77%	90%	95%	65%	79%	90%	98%	69%
18	Corridor T2	270	90	West	0,42	1,17	8,8			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
18	no shading	270	90	West	0,47	1,17	9,9			0,15	0,120	0,15	0,12				100%	84%	94%	79%	100%	94%	98%	92%
18		270	90	West	0,42	1,17	8,8			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
5	Corridor T2	270	90	West	0,42	1,17	2,5			0,15	0,120	0,15	0,12	75%	75%		100%	83%	94%	59%	100%	94%	98%	69%
5	страничен екра	270	90	West	0,47	1,17	2,7			0,15	0,120	0,15	0,12	75%	75%		100%	84%	94%	59%	100%	94%	98%	69%
5		270	90	West	0,42	1,17	2,5			0,15	0,120	0,15	0,12	75%	75%		100%	83%	94%	59%	100%	94%	98%	69%
3	Corridor T2	270	90	West	0,42	1,17	1,5	6,15	13,00	0,15	0,120	0,15	0,12				67%	83%	94%	53%	73%	94%	98%	67%
3	Shading 1fl.	270	90	West	0,47	1,17	1,6	6,15	13,00	0,15	0,120	0,15	0,12				67%	84%	94%	53%	73%	94%	98%	68%
3	old building	270	90	West	0,42	1,17	1,5	6,15	13,00	0,15	0,120	0,15	0,12				67%	83%	94%	53%	73%	94%	98%	67%
3	Corridor T2	270	90	West	0,42	1,17	1,5	2,60	13,00	0,15	0,120	0,15	0,12				84%	83%	94%	66%	87%	94%	98%	80%
3	Shading 2fl.	270	90	West	0,47	1,17	1,6	2,60	13,00	0,15	0,120	0,15	0,12				84%	84%	94%	67%	87%	94%	98%	81%
3	old building	270	90	West	0,42	1,17	1,5	2,60	13,00	0,15	0,120	0,15	0,12				84%	83%	94%	66%	87%	94%	98%	80%
4	Classroom T3 s	135	90	East	1,87	0,32	2,4	18,00	19,00	0,25	0,120	0,25	0,12				45%	93%	81%	34%	66%	95%	64%	40%
4	Level 1	135	90	East	0,42	1,17	2,0	18,00	19,00	0,25	0,120	0,25	0,12				45%	79%	92%	33%	66%	84%	90%	50%
4		135	90	East	0,47	1,17	2,2	18,00	19,00	0,25	0,120	0,25	0,12				45%	80%	92%	33%	66%	85%	90%	51%
4		135	90	East	0,42	1,17	2,0	18,00	19,00	0,25	0,120	0,25	0,12				45%	79%	92%	33%	66%	84%	90%	50%
4	Classroom T3 s	135	90	East	1,87	0,32	2,4	14,40	19,00	0,25	0,120	0,25	0,12				54%	93%	81%	41%	71%	95%	64%	43%
4	Level 2	135	90	East	0,42	1,17	2,0	14,40	19,00	0,25	0,120	0,25	0,12				54%	79%	92%	39%	71%	84%	90%	54%
4		135	90	East	0,47	1,17	2,2	14,40	19,00	0,25	0,120	0,25	0,12				54%	80%	92%	40%	71%	85%	90%	55%
4		135	90	East	0,42	1,17	2,0	14,40	19,00	0,25	0,120	0,25	0,12				54%	79%	92%	39%	71%	84%	90%	54%
4	Classroom T3 s	135	90	East	1,87	0,32	2,4	10,80	19,00	0,25	0,120	0,25	0,12				65%	93%	81%	49%	77%	95%	64%	46%
4	Level 3	135	90	East	0,42	1,17	2,0	10,80	19,00	0,25	0,120	0,25	0,12				65%	79%	92%	47%	77%	84%	90%	59%
4		135	90	East	0,47	1,17	2,2	10,80	19,00	0,25	0,120	0,25	0,12				65%	80%	92%	48%	77%	85%	90%	59%
4		135	90	East	0,42	1,17	2,0	10,80	19,00	0,25	0,120	0,25	0,12				65%	79%	92%	47%	77%	84%	90%	59%
4	Classroom T3 s	135	90	East	1,87	0,32	2,4	7,20	19,00	0,25	0,120	0,25	0,12				78%	93%	81%	58%	84%	95%	64%	50%
4	Level 4	135	90	East	0,42	1,17	2,0	7,20	19,00	0,25	0,120	0,25	0,12				78%	79%	92%	56%	84%	84%	90%	64%
4		135	90	East	0,47	1,17	2,2	7,20	19,00	0,25	0,120	0,25	0,12				78%	80%	92%	57%	84%	85%	90%	64%
4		135	90	East	0,42	1,17	2,0	7,20	19,00	0,25	0,120	0,25	0,12				78%	79%	92%	56%	84%	84%	90%	64%
4	Classroom T3 s	135	90	East	1,87	0,32	2,4	3,60	19,00	0,15	0,120	0,15	0,12				90%	95%	88%	75%	91%	97%	81%	71%
4	Level 5	135	90	East	0,42	1,17	2,0	3,60	19,00	0,15	0,120	0,15	0,12				90%	86%	95%	74%	91%	90%	96%	79%
4		135	90	East	0,47	1,17	2,2	3,60	19,00	0,15	0,120	0,15	0,12				90%	87%	95%	75%	91%	91%	96%	80%
4		135	90	East	0,42	1,17	2,0	3,60	19,00	0,15	0,120	0,15	0,12				90%	86%	95%	74%	91%	90%	96%	79%
25	Classroom T3 E	90	90	East	1,87	0,32	15,0			0,25	0,120	0,25	0,12				100%	91%	78%	70%	100%	97%	78%	75%
25		90	90	East	0,42	1,17	12,3			0,25	0,120	0,25	0,12				100%	74%	90%	67%	100%	90%	95%	86%
25		90	90	East	0,47	1,17	13,7			0,25	0,120	0,25	0,12				100%	76%	90%	68%	100%	91%	95%	86%
25		90	90	East	0,42	1,17	12,3			0,25	0,120	0,25	0,12				100%	74%	90%	67%	100%	90%	95%	86%
5	Classroom T3 E	90	90	East	1,87	0,32	3,0			0,15	0,120	0,15	0,12				100%	94%	86%	81%	100%	98%	90%	88%
5		90	90	East	0,42	1,17	2,5			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
5		90	90	East	0,47	1,17	2,7			0,15	0,120	0,15	0,12				100%	84%	94%	79%	100%	94%	98%	92%
5		90	90	East	0,42	1,17	2,5			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
5	Classroom T3 E	90	90	East	1,87	0,32	3,0			0,15	0,120	0,15	0,12	40%	40%		100%	94%	86%	32%	100%	98%	90%	35%
5		90	90	East	0,42	1,17	2,5			0,15	0,120	0,15	0,12	40%	40%		100%	83%	94%	31%	100%	94%	98%	37%
5		90	90	East	0,47	1,17	2,7			0,15	0,120	0,15	0,12	40%	40%		100%	84%	94%	32%	100%	94%	98%	37%
5		90	90	East	0,42	1,17	2,5			0,15	0,120	0,15	0,12	40%	40%		100%	83%	94%	31%	100%	94%	98%	37%
1	Steirs T4 Leve	0	90	North	0,52	1,27	0,7	16,00	11,00	0,15	0,120	0,15	0,12				46%	89%	95%	39%	53%	89%	98%	47%
2		0	90	North	0,42	1,27	1,1	16,00	11,00	0,15	0,120	0,15	0,12				46%	88%	95%	38%	53%	88%	98%	46%
1		0	90	North	0,52	1,27	0,7	16,00	11,00	0,15	0,120	0,15	0,12				46%	89%	95%	39%	53%	89%	98%	47%
1	Steirs T4 Leve	0	90	North	0,52	1,27	0,7	12,40	11,00	0,15	0,120	0,15	0,12				51%	89%	95%	43%	57%	89%	98%	50%
2		0	90	North	0,42	1,27	1,1	12,40	12,00	0,15	0,120	0,15	0,12				52%	88%	95%	43%	58%	88%	98%	50%
1		0	90	North	0,52	1,27	0,7	12,40	13,00	0,15	0,120	0,15	0,12				54%	89%	95%	46%	59%	89%	98%	52%
1	Steirs T4 Leve	0	90	North	0,52	1,27	0,7	8,80	14,00	0,15	0,120	0,15	0,12				63%	89%	95%	53%	67%	89%	98%	59%
2		0	90	North	0,42	1,27	1,1	8,80	15,00	0,15	0,120	0,15	0,12				65%	88%	95%	54%	68%	88%	98%	59%
1		0	90	North	0,52	1,27	0,7	8,80	16,00	0,15	0,120	0,15	0,12				66%	89%	95%	56%	69%	89%	98%	61%
1	Steirs T4 Leve	0	90	North	0,52	1,27	0,7	5,20	17,00	0,15	0,120	0,15	0,12				78%	89%	95%	66%	80%	89%	98%	70%
2		0	90	North	0,42	1,27	1,1	5,20	18,00	0,15	0,120	0,15	0,12				79%	88%	95%	66%	81%	88%	98%	70%
1		0	90	North	0,52	1,27	0,7	5,20	19,00	0,15	0,120	0,15	0,12				80%	89%	95%	67%	81%	89%	98%	71%
1	Steirs T4 Leve	0	90	North	0,52	0,47	0,2	2,70	20,00	0,15	0,120	0,15	0,12				89%	89%	89%	71%	90%	89%	94%	75%
2		0	90	North	0,42	0,47	0,4	2,70	21,00	0,15	0,120	0,15	0,12				90%	88%	89%	70%	90%	88%	94%	74%
1		0	90	North	0,52	0,47	0,2	2,70	22,00	0,15	0,120	0,15	0,12				90%	89%	89%	71%	91%	89%	94%	76%
1	Door T5 lev. 2	270	90	West	0,57	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	62%	52%	21%	70%	84%	45%	27%
1		270	90	West	0,77	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	68%	52%	23%	70%	87%	45%	28%
1		270	90	West	0,57	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	62%	52%	21%	70%	84%	45%	27%
3		270	90	West	0,15	0,28	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	41%	59%	15%	70%	71%	53%	26%
6		270	90	West	0,15	0,28	0,2	6,95	13,00	0,50	0,120	0,50	0,12				64%	41%	59%	15%	70%	71%	53%	26%

Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%	%	%	%	%	%	%
					w_G	h_G	A_G	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	$r_{other,w}$	$r_{other,s}$	z	r_H	r_R	r_O	r_S	r_H	r_R	r_O	r_S
1		270	90	West	0,77	1,42	1,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	68%	84%	37%	70%	87%	88%	54%
3		270	90	West	0,15	0,28	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	41%	59%	15%	70%	71%	53%	26%
1		270	90	West	0,57	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	62%	52%	21%	70%	84%	45%	27%
1		270	90	West	0,77	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	68%	52%	23%	70%	87%	45%	28%
1		270	90	West	0,57	0,17	0,1	6,95	13,00	0,50	0,120	0,50	0,12				64%	62%	52%	21%	70%	84%	45%	27%
1	Corridor T7	270	90	West	0,42	1,17	0,5			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
2		270	90	West	0,47	1,17	1,1			0,15	0,120	0,15	0,12				100%	84%	94%	79%	100%	94%	98%	92%
1		270	90	West	0,42	1,17	0,5			0,15	0,120	0,15	0,12				100%	83%	94%	78%	100%	94%	98%	92%
3	Lobby T8	0	90	North	0,62	0,72	1,3			0,15	0,140	0,15	0,14				100%	91%	92%	83%	100%	91%	97%	88%
3		0	90	North	0,32	0,72	0,7			0,15	0,140	0,15	0,14				100%	86%	92%	80%	100%	87%	97%	84%
3		0	90	North	0,62	0,72	1,3			0,15	0,140	0,15	0,14				100%	91%	92%	83%	100%	91%	97%	88%
3		0	90	North	0,62	1,32	2,5			0,15	0,140	0,15	0,14				100%	91%	95%	86%	100%	91%	99%	89%
3		0	90	North	0,32	1,32	1,3			0,15	0,140	0,15	0,14				100%	86%	95%	82%	100%	87%	99%	85%
3		0	90	North	0,62	1,32	2,5			0,15	0,140	0,15	0,14				100%	91%	95%	86%	100%	91%	99%	89%
1	Lobby T9	180	90	South	0,72	0,72	0,5			0,15	0,140	0,15	0,14				100%	93%	94%	88%	100%	91%	89%	81%
1		180	90	South	0,47	0,72	0,3			0,15	0,140	0,15	0,14				100%	91%	94%	85%	100%	88%	89%	78%
1		180	90	South	0,72	0,72	0,5			0,15	0,140	0,15	0,14				100%	93%	94%	88%	100%	91%	89%	81%
1		180	90	South	0,72	1,32	1,0			0,15	0,140	0,15	0,14				100%	93%	96%	89%	100%	91%	95%	87%
1		180	90	South	0,47	1,32	0,6			0,15	0,140	0,15	0,14				100%	91%	96%	87%	100%	88%	95%	84%
1		180	90	South	0,72	1,32	1,0			0,15	0,140	0,15	0,14				100%	93%	96%	89%	100%	91%	95%	87%
2	Lobby Door T10	180	90	South	0,72	0,72	1,0			0,15	0,100	1,00	0,080				100%	92%	64%	59%	100%	90%	24%	21%
2		180	90	South	0,72	0,72	1,0			0,15	0,100	1,00	0,080				100%	92%	64%	59%	100%	90%	24%	21%
2		180	90	South	0,72	1,32	1,9			0,15	0,100	1,00	1,080				100%	92%	89%	82%	100%	90%	69%	62%
2		180	90	South	0,72	1,32	1,9			0,15	0,100	1,00	1,080				100%	92%	89%	82%	100%	90%	69%	62%
2	solid	180	90	South	0,72	0,72	1,0			0,15	0,100	0,15	0,10	0%	0%		100%	92%	94%	0%	100%	90%	87%	0%
2	solid	180	90	South	0,72	0,72	1,0			0,15	0,100	0,15	0,10	0%	0%		100%	92%	94%	0%	100%	90%	87%	0%
1	Lobby T11	180	90	South	0,82	0,72	0,6			0,15	0,140	0,15	0,14				100%	93%	94%	88%	100%	92%	89%	82%
2		180	90	South	0,47	0,72	0,7			0,15	0,140	0,15	0,14				100%	91%	94%	85%	100%	88%	89%	78%
2		180	90	South	0,82	0,72	1,2			0,15	0,140	0,15	0,14				100%	93%	94%	88%	100%	92%	89%	82%
1		180	90	South	0,82	0,72	0,6			0,15	0,140	0,15	0,14				100%	93%	94%	88%	100%	92%	89%	82%
1		180	90	South	0,82	1,32	1,1			0,15	0,140	0,15	0,14				100%	93%	96%	90%	100%	92%	95%	87%
2		180	90	South	0,47	1,32	1,2			0,15	0,140	0,15	0,14				100%	91%	96%	87%	100%	88%	95%	84%
2		180	90	South	0,82	1,32	2,2			0,15	0,140	0,15	0,14				100%	93%	96%	90%	100%	92%	95%	87%
1		180	90	South	0,82	1,32	1,1			0,15	0,140	0,15	0,14				100%	93%	96%	90%	100%	92%	95%	87%

EnerPHit planning: **V E N T I L A T I O N D A T A**

Building: School "Tzanko Diustabanov"-Block A

Treated floor area A_{TFA}		m²	1303	*(Areas worksheet)*
Room Height h		m	2,50	
Room ventilation volume (A_{TFA}*h) =	V_V	m³	3259	*(Worksheet Annual heating)*

Ventilation type

Please select: Window ventilation only

Infiltration air change rate

Wind protection coefficients e and f	Several side exposed	One side exposed
Coefficient e for screening class		
No screening	0,10	0,03
Moderate screening	0,07	0,02
High screening	0,04	0,01
Coefficient f	15	20

			for annual demand:	for Heating Load:				
Wind protection coefficient, e			0,07	0,18				
Wind protection coefficient, f			15	15	Net Air Volume for Press. Test	V_{n50}	Air permeability	q_{50}
Air Change Rate at Press. Test	n_{50}	1/h	4,00	4,00		m³		m³/(hm²)

			for annual demand:	for Heating Load:
Excess extract air		1/h	0,00	0,00
Infiltration air change rate	$n_{V,Rest}$	1/h		

Selection of ventilation data input - Results

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

	Ventilation unit / Heat recovery efficiency design		Average Air Exchange m³/h	Average Air Change Rate 1/h	Extract air excess (Extract air system) 1/h	Effective heat recovery efficiency Unit [-]	Energy recovery value [-]	Specific power input Wh/m³	Heat recovery efficiency SHX [-]
	Standard design	*(Ventilation worksheet see below)*							
x	Various vent. units, non residential	*(Worksheet Additional vent)*							
			682	0,21	0,00			0,00	0,0%

SHX efficiency η^*_{SHX} 0%

STANDARD INPUT FOR BALANCED VENTILATION

Ventilation dimensioning for systems with one ventilation unit

Calculation in sheet 'Additional Vent': Extended data input for balanced ventilation

Occupancy	m²/P	6				
Number of occupants	P	225,0				
Supply air per person	m³/(P*h)	30				
Supply air requirement	m³/h	6750				
Extract air rooms		Kitchen	Bathroom	Bathroom (shower only)	WC	
Quantity						
Extract air requirement per room	m³/h	60	40	20	20	
Total Extract Air Requirement	m³/h	0				

Design air flow rate (maximum) m³/h

Average air change rate calculation

Type of operation	Daily operation duration h/d	Factors referenced to maximum	Air flow rate m³/h	Air change rate 1/h
maximum		1,00	#WERT!	#WERT!
Standard	24,0	0,77	#WERT!	#WERT!
Basic		0,54	#WERT!	#WERT!
Minimum		0,40	#WERT!	#WERT!
			Average air flow rate (m³/h)	Average air change rate (1/h)
	Average value	0,77		

Selection of ventilation unit with heat recovery

Installation site of ventilation unit

No heat recovery. Please enter electrical efficiency data.

Sort: BY ID

Ventilation unit selection	Heat recovery efficiency Unit η_{HR}	Energy recovery η_{ERV}	Specific power input [Wh/m³]	Application range [m³/h]	Frost required

Go to ventilation units list

Ψ	W/(mK)	0,000	See calculation below
	m		
Ψ	W/(mK)	0,000	See calculation below
	m		
Temperature of mechanical services room (Enter only if the central unit is outside of the thermal envelope.)	°C		

Room temperature (°C)	20
Av. Ambient Temp. Heating P. (°C)	4,3
Av. Ground Temp (°C)	11,7

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

Effective heat recovery efficiency subsoil heat exchanger

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

Secondary calculation

Ψ-value supply or ambient air duct

Nominal width:		mm
Insul. Thickness:		mm
Reflective?		Yes
	x	No
Thermal conductivity		W/(mK)
Nominal air flow rate		m³/h
Δϑ	16	K
Exterior duct diameter	0,000	m
Exterior diameter	0,000	m
α-Interior	0,00	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

Secondary calculation

Ψ-value extract or exhaust air duct

Nominal width:		mm
Insul. Thickness:		mm
Reflective?		yes
	x	no
Thermal conductivity		W/(mK)
Nominal air flow rate		m³/h
Δϑ	16	K
Exterior duct diameter	0,000	m
Exterior diameter	0,000	m
α-Interior	0,00	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

EnerPHit planning: # EXTENDED DATA INPUT FOR BALANCED VENTILATION

Planning ventilation systems with multiple ventilation units

Building: School "Tzanko Diustabanov"-Block A

Ventilation unit / Heat recovery efficiency design			
In Ventilation worksheet (standard design)			*(Ventilation worksheet)*
In Additional Vent (this worksheet)		x	*(Additional vent)*
Treated Floor Area A_{TFA}	m²	1303	*(Areas worksheet)*
Room Height h	m	2,50	*(Worksheet Annual heating)*
Room air volume for ventilation (A_{TFA}*h) = V_v	m³	3259	*(Worksheet Annual heating)*
Number of Occupants	P	225,0	*(Ventilation worksheet)*
Room temperature	°C	20	*(Worksheet Annual heating)*
Average external temp. heating period	°C	4,3	*(Ventilation worksheet)*
Average ground temp.	°C	11,7	*(Ground worksheet)*
Ventilation type		Window ventilation only	*(Ventilation worksheet)*

Results of ventilation design and unit selection:

Venti-lation Unit no.	Description of the unit	Design V_{SUP} m³/h	Design V_{ETA} m³/h	Average value / yr. V_{SUP} m³/h	Average value / yr. V_{ETA} m³/h	Air ch.rt. 1/h	Effective heat recovery efficiency	Energy recovery value	spec. Input power	Heat recov. efficiency SHX	Cross check
1	Floor 1	1500	1500	160	160	---		0%	0,40	0%	Please assign a ventilation unit
2	Floor 2	1200	1200	128	128	---		0%	0,40	0%	Please assign a ventilation unit
3	Floor 3	1200	1200	128	128	---		0%	0,40	0%	Please assign a ventilation unit
4	Floor 4	1200	1200	128	128	---		0%	0,40	0%	Please assign a ventilation unit
5	Floor 5	1300	1300	139	139	---		0%	0,40	0%	Please assign a ventilation unit
6						---					
7						---					
8						---					
9						---					
10						---					
Result for overall vent. syst.		**6400**	**6400**	**682**	**682**	**0,21**	No heat recovery. Irrelevant input			**0%**	

Recommendations for dimensioning air quantities

Use of low odour and low-emission building materials/ furnishings:
It is strongly recommended to use building materials that cause no or only little pollution instead of increasing the outdoor air volume flow in order to reduce preventable pollution.
This holds true independently from the chosen approach for the air quality determination; emissions of all sources in the room should be considered, e.g. furniture, carpets and ventilation or air-conditioning unit.

Assessment of volume flow rates according to the number of persons
Also in non-residential buildings, the number of persons is fundamentally important for assessing the volume air flow rates. For good indoor air quality the amounts of 20 to 30 m³/h/person are completely sufficient.
Higher outdoor air amounts may lead to excessively dry indoor air in winter. The air flow rates are specified by classification according to EN 13779. The classification must be agreed with the client in advance.
IDA 3 is adequate for office buildings. IDA 4 has proven satisfactory for school buildings as purge ventilation is carried out during breaks anyway. For typical external air CO_2 concentrations of around 400-500 ppm, it is possible to comply even with 1500 ppm. Exceeding this figure temporarily is permissible.

Fresh air flow rates per person:
- Recommended for residential buildings: around 30 m³/(h person)
- Recommended for offices and similar uses: around 30 m³/(h person) (AMEV: 28 m³/(h person); EN 13779 / IDA 3: at least 24 m³/(h person))
- Recommended for schools and day care centres: 15 to 20 m³/(h person) (Source: Guidelines for energy-efficient educational buildings, Passive House Institute, 2010)
- Recommendation for sport halls: 60 m³/(h person) (DIN 18032-1)

Purging phase for intermittent ventilation operation
Due to the purge ventilation phase, the ventilation operation period is extended accordingly (utilisation time + purge ventilation phase). Please consider this for the ventilation design.
Emissions have to be removed. Flushing the building prolongs the utilization time of the ventilation system (utilization time + flushing phase). Please consider this at design stage.

Design of air quantities

When designing the air quantities, please consider the design recommendations given above.
The ventilation operation period can be determined on the basis of the daily utilisation hours including purging phase if applicable. In addition, time periods with reduced ventilation requirements (operation modes) can be
Taken into account by means of reduction factors.

Room Nr.	Amount a	Room name	Asignment to ventilation unit	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Air change rate per room n 1/h	Utilisation times h/d h	d/week d	weeks/yr Weeks	Reduction Red.1	Operation Red. 1	Reduction Red.2	Operation Red.2	Reduction Red.3	Operation Red. 3	Cross check	Average volume flows V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Average air change rate 1/h
1	1	Lobby	1	186	4,00	744	300	500		0,67	12	5	32	100%	15%	60%	15%	35%	70%		32	53		0,07
2	1	Corridor L1	1	74	3,40	252		500	600	2,38	12	5	32	100%	15%	60%	15%	35%	70%			53	64	0,25
3	2	Classroom	1	45	3,40	152	400			2,64	12	5	32	100%	15%	60%	15%	35%	70%		85			0,28
4	1	Classroom Sou	1	58	3,40	197	400			2,03	12	5	32	100%	15%	60%	15%	35%	70%		43			0,22
5	1	Classroom sto	1	24	3,40	82		100		1,23	12	5	32	100%	15%	60%	15%	35%	70%			11		0,13
6	1	WC's level 1	1	13	3,40	44		200		4,52	12	5	32	100%	15%	60%	15%	35%	70%			21		0,48
7	1	WC's level 2	1	15	3,40	51		200		3,92	12	5	32	100%	15%	60%	15%	35%	70%			21		0,42
8	1	Corridor L2	2	64	3,40	216		600	600	2,78	12	5	32	100%	15%	60%	15%	35%	70%			64	64	0,30
9	2	Classroom 1	2	45	3,40	153	400			2,61	12	5	32	100%	15%	60%	15%	35%	70%		85			0,28
10	1	Classroom Sou	2	58	3,40	197	400			2,03	12	5	32	100%	15%	60%	15%	35%	70%		43			0,22
11	1	Classroom sto	2	24	3,40	82		100		1,23	12	5	32	100%	15%	60%	15%	35%	70%			11		0,13
12	1	WC's level 2	2	13	3,40	44		250		5,66	12	5	32	100%	15%	60%	15%	35%	70%			27		0,60
13	1	WC's level 3	2	15	3,40	51		250		4,90	12	5	32	100%	15%	60%	15%	35%	70%			27		0,52
14	1	Corridor L3	3	64	3,40	216		600	600	2,78	12	5	32	100%	15%	60%	15%	35%	70%			64	64	0,30
15	2	Classroom 1	3	45	3,40	153	400			2,61	12	5	32	100%	15%	60%	15%	35%	70%		85			0,28
16	1	Classroom Sou	3	58	3,40	197	400			2,03	12	5	32	100%	15%	60%	15%	35%	70%		43			0,22
17	1	Classroom sto	3	24	3,40	82		100		1,23	12	5	32	100%	15%	60%	15%	35%	70%			11		0,13
18	1	WC's level 2	3	13	3,40	44		250		5,66	12	5	32	100%	15%	60%	15%	35%	70%			27		0,60
19	1	WC's level 3	3	15	3,40	51		250		4,90	12	5	32	100%	15%	60%	15%	35%	70%			27		0,52
20	1	Corridor L4	4	64	3,40	216		600	600	2,78	12	5	32	100%	15%	60%	15%	35%	70%			64	64	0,30
21	2	Classroom 1	4	45	3,40	153	400			2,61	12	5	32	100%	15%	60%	15%	35%	70%		85			0,28
22	1	Classroom Sou	4	58	3,40	197	400			2,03	12	5	32	100%	15%	60%	15%	35%	70%		43			0,22
23	1	Classroom sto	4	24	3,40	82		100		1,23	12	5	32	100%	15%	60%	15%	35%	70%			11		0,13
24	1	WC's level 2	4	13	3,40	44		250		5,66	12	5	32	100%	15%	60%	15%	35%	70%			27		0,60
25	1	WC's level 3	4	15	3,40	51		250		4,90	12	5	32	100%	15%	60%	15%	35%	70%			27		0,52
26	1	Corridor L5	5	64	3,40	216		750	350	3,47	12	5	32	100%	15%	60%	15%	35%	70%			80	37	0,37
27	2	Classroom 1	5	45	3,40	153	400			2,61	12	5	32	100%	15%	60%	15%	35%	70%		85			0,28
28	1	Classroom Sou	5	58	3,40	197	400			2,03	12	5	32	100%	15%	60%	15%	35%	70%		43			0,22
29	1	Classroom sto	5	24	3,40	82		200		2,45	12	5	32	100%	15%	60%	15%	35%	70%			21		0,26
30	1	Cabinet	5	13	3,40	44	100			2,26	12	5	32	100%	15%	60%	15%	35%	70%		11			0,24
31	1	Storage room	5	17	3,40	58		350		6,06	12	5	32	100%	15%	60%	15%	35%	70%			37		0,65
32														100%	100%									
33														100%	100%									
34														100%	100%									
	Additional lines: Please mark complete lines above, copy and paste multiple times																				682	682	---	0,13

Ventilation unit selection

Up to 10 different ventilation units are considered. By changing the amount, identical units can be considered. The data from PHI certified ventilation units
as well as the entry data lines for user data for other ventilation units can also be found in the worksheet "Components". When choosing to use a compact unit the standard design in the Ventilation worksheet has to be used.

Go to ventilation units list

Venti-lation Unit no.	Quan-tity [-]	Description Ventilation units	Selection Unit type	Design vol. flow per unit m³/h	Entry area for volume flow rate from m³/h	to m³/h	Electrical efficiency Wh/m³	Pressure loss calculation ODA-SUP Δp_{duct} Pa	ETA-EHA Δp_{duct} Pa	Additional Δp_{intern} Pa	Entry area per line $\Delta p_{external}$ Pa	Subtraction Δp_{intern} Pa	Cross check ---------- Pressure loss assessment duct network	Interior location (x)	Exterior location (x)	Heat recovery efficiency Unit [-]	effective [-]	Energy recovery value [-]	Frost protection necessary	Subsoil HX Effective-efficiency degree	Efficiency of heat recovery	Noise protecti U noise level < 35dB(A)	adapter Supply air db(A)
																No heat recovery. Irrelevant input							
			Change sorting type																				
1	1	Floor 1	06ud Tangra ventilation unit EVB 16 Hi	1500	800	1600	0,40	60	60	70	-	-	ok	x		0,82	80%	0%	yes		0%	n.a.	68
2	1	Floor 2	05ud Tangra ventilation unit EVB 12 Hi	1200	750	1200	0,40	55	55	60	-	-	ok	x		0,82	80%	0%	yes		0%	n.a.	68
3	1	Floor 3	05ud Tangra ventilation unit EVB 12 Hi	1200	750	1200	0,40	55	55	60	-	-	ok	x		0,82	81%	0%	yes		0%	n.a.	68
4	1	Floor 4	05ud Tangra ventilation unit EVB 12 Hi	1200	750	1200	0,40	55	55	60	-	-	ok	x		0,82	81%	0%	yes		0%	n.a.	68
5	1	Floor 5	06ud Tangra ventilation unit EVB 16 Hi	1300	800	1600	0,40	55	55	60	-	-	ok	x		0,82	81%	0%	yes		0%	n.a.	68
6																							
7																							
8																							
9																							
10																							

Data entries for duct sections between the ventilation unit and the thermal envelope

The duct sections between the ventilation unit and the thermal envelope should be as short as possible and should be well insulated, both for interior as for exterior location of the ventilation unit. These duct sections can be entered here. The heat losses of the overlying duct section will be considered for the effective heat recovery efficiency.
An entered duct section can also be used for multiple ventilation units.
If in the section "Ventilation unit - selection" in one line a ventilation unit is selected as multiple units (amount larger than 1 for identical units), then the corresponding duct sections may simply be entered (duct sections for one ventilation unit).

Temperature of the location of installation (only enter when at least one unit is installed outside of the thermal envelope)

Quan-tity	Cross check	Round duct ins. diameter mm	Rectangular duct Width mm	Height mm	Insulation Thickness mm	Thermal conducti-vity W/(m K)	Reflective insulation duct (x)	Transmittance duct W/(m K)	Length of Supply air m	Ambient or Extract air Duct (1)	Exhaust or flow Duct (1)	Duct type	Design Volume rate	Allocation to ventilation units (when central unit applicable enter "1") Vent. Unit 1	Vent. Unit 2	Vent. Unit 3	Vent. Unit 4	Vent. Unit 5	Vent. Unit 6	Vent. Unit 7	Vent. Unit 8	Vent. Unit 9	Vent. Unit 10
1		315			150	0,033		0,292	4	1		Ambient air	1500	1									
1		315			150	0,033		0,292	15,5		1	Fortluft	1500	1									
1		315			150	0,033		0,291	4	1		Ambient air	1200		1								
1		315			150	0,033		0,291	11,9		1	Fortluft	1200		1								
1		315			150	0,033		0,291	4	1		Ambient air	1200			1							
1		315			150	0,033		0,291	8,3		1	Fortluft	1200			1							
1		315			150	0,033		0,291	4	1		Ambient air	1200				1						
1		315			150	0,033		0,291	4,7		1	Fortluft	1200				1						
1		315			150	0,033		0,291	4	1		Ambient air	1300					1					
1		315			150	0,033		0,291	1,1		1	Fortluft	1300					1					
													0										
													0										
													0										
													0										
													0										
													0										
													0										
													0										
													0										

Additional lines: Please mark complete lines above, copy and paste multiple times

EnerPHit planning: # SPECIFIC ANNUAL HEATING DEMAND (annual method)

Climate: User data - Велико Търнов PHI
Building: School "Tzanko Diustabanov"-Block A

Interior Temperature: 20,0 °C
Building type: School
Treated Floor Area A_{TFA}: 1303,5 m²

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Temp. Factor f_t		G_t kKh/a		kWh/a	per m² Treated Floor Area kWh/(m²a)
Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	*	74,4	=	135385	103,87
Exterior Wall - Ground	B		*		*	0,12	*		=		
Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	*	74,4	=	125645	96,39
Floor slab / basement ceiling	B	549,8	*	2,012	*	0,12	*	74,4	=	10119	7,76
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	433,8	*	2,513	*	1,00	*	74,4	=	81081	62,20
Exterior Door	A	2,0	*	5,500	*	1,00	*	74,4	=	818	0,63
Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	*	74,4	=	-9571	-7,34
Perimeter TB (length/m)	P	110,2	*	-0,380	*	0,12	*	74,4	=	-383	-0,29
Ground TB (length/m)	B		*		*	0,12	*		=		0,00
Total of all building envelope areas		2900,9									kWh/(m²a)
Transmission heat losses Q_T									Total	343096	263,2

Ventilation System:

		A_{TFA} m²		Clear Room Height m		m³
Effective Air Volume, V_V		1303,5	*	2,50	=	3258,7

Effective heat recovery efficiency of heat recovery: η_{eff} = 0%
Efficiency of Subsoil Heat Exchanger: η_{SHX} = 0%

	$n_{V,system}$ 1/h		η_{HR}		$n_{V,Res}$ 1/h		1/h
Energetically Effective Air Exchange n_v	0,209	* (1 -	0,00	) +	0,046	=	0,256

	V_V m³		n_V 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation heat losses Q_V	3258,7	*	0,256	*	0,33	*	74,4	=	20441	15,7

	Q_T kWh/a		Q_V kWh/a		Reduction Factor Night/Weekend Saving	kWh/a	kWh/(m²a)
Total heat losses Q_L	(343096	+	20441	)	1,0	= 363537	278,9

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Radiation HP kWh/(m²a)		kWh/a
1. North	0,26	*	0,77	*	52,75	*	122	=	1291
2. East	0,23	*	0,77	*	242,41	*	287	=	12116
3. South	0,33	*	0,81	*	36,89	*	432	=	4305
4. West	0,27	*	0,77	*	101,73	*	243	=	5128
5. Horizontal	0,00	*	0,00	*	0,00	*	400	=	0
Available Solar Heat Gains Q_S								Total	22841	kWh/(m²a) 17,5

	kh/d		Length heating period d/a		Spec. Power q_i W/m²		A_{TFA} m²	kWh/a	kWh/(m²a)
Internal Heat Gains Q_I	0,024	*	189	*	2,80	*	1303,5	= 16570	12,7

		kWh/a	kWh/(m²a)
Free Heat Q_F	Q_S + Q_I =	39410	30,2
Ratio of Free Heat to Losses	Q_F / Q_L =	0,11	
Utilisation Factor Heat Gains η_G	(1 - (Q_F / Q_L)^5) / (1 - (Q_F / Q_L)^6) =	100%	
Heat Gains Q_G	η_G * Q_F =	39410	30,2

		kWh/a	kWh/(m²a)
Annual heating demand QH	Q_L - Q_G =	324128	**249**

	kWh/(m²a)	(Yes/No)
Limiting value	25	**Requirement met?** no

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

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

Climate: Велико Търнов PHI | Interior Temperature: 20 °C

Building: School "Tzanko Diustabanov"-Block A | Building type: School

Spec. Capacity: 204 Wh/(m²K) | Treated Floor Area A_{TFA}: 1303,5 m²

Transmission heat losses Q_T

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Month. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area kWh/(m²a)
Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	*	87	=	158028	121,24
Exterior Wall - Ground	B		*		*	1,00	*		=		
Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	*	87	=	146659	112,52
Floor slab / basement ceiling	B	549,8	*	2,012	*	1,00	*	13	=	13997	10,74
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	433,8	*	2,513	*	1,00	*	87	=	94642	72,61
Exterior Door	A	2,0	*	5,500	*	1,00	*	87	=	955	0,73
Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	*	87	=	-11171	-8,57
Perimeter TB (length/m)	P	110,2	*	-0,380	*	1,00	*	13	=	-529	-0,41
Ground TB (length/m)	B		*		*	1,00	*		=		0,00
									Total	402580	kWh/(m²a) 308,9

Ventilation heat losses Q_V

Effective Air Volume V_V: A_{TFA} 1303 m² * Clear Room Height 2,50 m = 3259 m³

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{V,e}$	0,209	*(1-	0%	)*(1-	0,00	)+	0,046	=	0,256
Effective Air Change Rate Ground $n_{V,g}$	0,209	*	0%	*(1-	0,00	)		=	0,000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	3259	*	0,256	*	0,33	*	87	=	23860	18,3
Ventilation losses ground $Q_{V,e}$	3259	*	0,000	*	0,33	*	61	=	0	0,0
								Total	23860	18,3

Total heat losses Q_L

Q_T kWh/a		Q_V kWh/a		Reduction Factor Night/Weekend Saving		kWh/a	kWh/(m²a)
(402580	+	23860	) *	1,0	=	426440	327,2

Available Solar Heat Gains Q_S

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
North	0,26	*	0,77	*	52,7	*	284	=	3006
East	0,23	*	0,77	*	242,4	*	625	=	26390
South	0,33	*	0,81	*	36,9	*	780	=	7765
West	0,27	*	0,77	*	101,7	*	554	=	11692
Horizontal	0,00	*	0,00	*	0,0	*	959	=	0
Sum opaque areas									44824
								Total	93678

kWh/(m²a) 71,9

Internal Heat Gains Q_I

kh/d		Length Heat. Period d/a		Spec. Power q_i W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
0,024	*	303	*	2,8	*	1303,5	=	26541	20,4

		kWh/a	kWh/(m²a)
Free Heat Q_F	Q_S + Q_I =	120218	92,2
Ratio Free Heat to Losses	Q_F / Q_L =	0,28	
Utilisation Factor Heat Gains η_G	=	84%	
Heat Gains Q_G	η_G * Q_F =	100499	77,1
Annual heating demand QH	Q_L - Q_G =	325942	**250**

Limiting value kWh/(m²a): 25

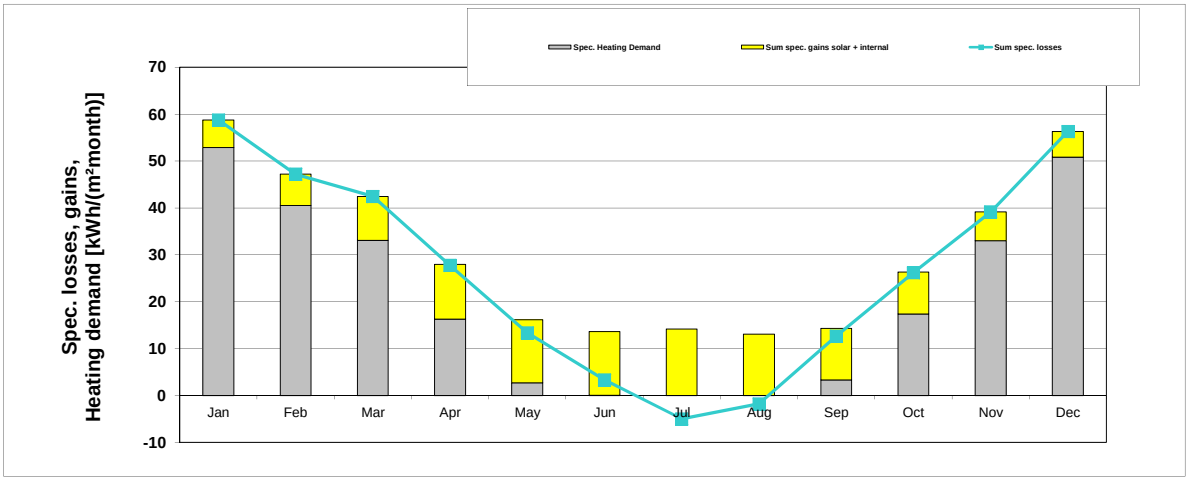
Requirement met? (Yes/No): **no**

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

Climate: Велико Търнов PHI
Building: School "Tzanko Diustabanov"-Block A

Interior Temperature: 20 °C
Building type: School
Treated Floor Area A_{TFA}: 1303 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	15,7	12,6	11,3	7,3	3,4	0,7	-0,9	-0,6	3,3	7,0	10,5	15,1	85	kKh
Heating Degree Hours - Ground	1,7	1,6	1,7	1,4	1,2	0,9	-2,3	0,6	0,7	0,9	1,2	1,5	11	kKh
Losses - Exterior	74805	59855	53558	34651	16161	3422	-4069	-2982	15742	33192	49783	71804	405922	kWh
Losses - Ground	1800	1688	1776	1497	1242	914	-2467	663	731	985	1248	1588	11664	kWh
Sum spec. losses	58,8	47,2	42,5	27,7	13,4	3,3	-5,0	-1,8	12,6	26,2	39,1	56,3	320,4	kWh/m²
Solar gains - North	148	201	296	392	508	572	540	466	339	254	159	138	4012	kWh
Solar gains - East	1512	1809	2639	3549	4083	4136	4297	3867	3254	2527	1541	1338	34554	kWh
Solar gains - South	607	677	846	896	856	806	866	926	956	906	647	567	9557	kWh
Solar gains - West	570	739	1224	1562	1899	1899	2005	1878	1520	1140	654	485	15576	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	2133	2856	4489	6183	7488	7708	8079	7199	5636	4069	2380	1882	60103	kWh
Internal Heat Gains	2715	2453	2715	2628	2715	2628	2715	2715	2628	2715	2628	2715	31971	kWh
Sum spec. gains solar + internal	5,9	6,7	9,4	11,7	13,5	13,6	14,2	13,1	11,0	8,9	6,1	5,5	119,5	kWh/m²
Utilisation Factor	100%	100%	100%	98%	79%	24%	100%	100%	85%	99%	100%	100%	59%	
Annual heating demand	68920	52812	43151	21245	3496	13	0	0	4332	22681	43026	66266	325942	kWh
Spec. Heating Demand	**52,9**	**40,5**	**33,1**	**16,3**	**2,7**	**0,0**	**0,0**	**0,0**	**3,3**	**17,4**	**33,0**	**50,8**	**250,1**	kWh/m²



Annual heating demand: Comparison

Monthly method	*(Worksheet Heat*	**325942**	**kWh/a**	**250,1**	**kWh/(m²a) reference to treated floor area according to PHPP**
Annual method	*(Worksheet Ann*	**324128**	**kWh/a**	**248,7**	**kWh/(m²a) reference to treated floor area according to PHPP**

EnerPHit planning: # SPECIFIC SPACE HEATING LOAD

Building: School "Tzanko Diustabanov"-Block A — Building type: School

Climate (HL): Велико Търнов PHI — Treated Floor Area A_{TFA}: 1303,5 m² — Interior Temperature: 20 °C

	Design Temperature		Radiation:	North	East	South	West	Horizontal	
Weather 1:	-9,1	°C		19	39	82	35	56	W/m²
Weather 2:	-4,6	°C		16	23	40	24	36	W/m²
Ground Design Temp.	17,6	°C							

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	*	29,1	or	24,6	=	52910	or	44719
2.	Exterior Wall - Ground	B		*		*	1,00	*	2,4	or	2,4	=		or	
3.	Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	*	29,1	or	24,6	=	49103	or	41502
4.	Floor slab / basement ceiling	B	549,8	*	2,012	*	1,00	*	2,4	or	2,4	=	2611	or	2611
5.		A		*		*	1,00	*	29,1	or	24,6	=		or	
6.		A		*		*	1,00	*	29,1	or	24,6	=		or	
7.		X		*		*	0,75	*	29,1	or	24,6	=		or	
8.	Windows	A	433,8	*	2,513	*	1,00	*	29,1	or	24,6	=	31687	or	26782
9.	Exterior Door	A	2,0	*	5,500	*	1,00	*	29,1	or	24,6	=	320	or	270
10.	Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	*	29,1	or	24,6	=	-3740	or	-3161
11.	Perimeter TB (length/m)	P	110,2	*	-0,380	*	1,00	*	2,4	or	2,4	=	-99	or	-99
12.	Ground TB (length/m)	B		*		*	1,00	*	2,4	or	2,4	=		or	
13.	House/DU Partition Wall	I	70,1	*	1,347	*	1,00	*	3,0	or	3,0	=	283	or	283

Transmission heat load P_T

Total = 133075 or 112907

Ventilation System:

Effective Air Volume, V_V: A_{TFA} 1303,5 m² * Clear Room Height 2,50 m = 3259 m³

Heat recovery efficiency of the Heat Exchanger η_{HR} 0% — Heat Recovery Efficiency SHX 0% — Efficiency SHX η_{SHX} 1: 0% or η_{SHX} 2: 0%

Energetically Effective Air Exchange n_V: $n_{V,Res}$ (Heating Load) 0,105 1/h + $n_{V,system}$ 0,209 1/h *(1- Φ_{HR} 0,00 or Φ_{HR} 0,00) = 0,314 1/h or 0,314 1/h

Ventilation heat load P_V

V_V m³		n_V 1/h		n_V 1/h	c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
3258,7	*	0,314	or	0,314	* 0,33	*	29,1	or	24,6	=	9827	or	8306

Total heating load P_L

$P_T + P_V$ = P_L 1: 142901 W or P_L 2: 121213 W

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	52,7	*	0,8	*	0,26	*	19	or	16	=	201	or	169
2.	East	242,4	*	0,8	*	0,23	*	49	or	27	=	2084	or	1138
3.	South	36,9	*	0,8	*	0,33	*	82	or	40	=	816	or	398
4.	West	101,7	*	0,8	*	0,27	*	35	or	24	=	739	or	507
5.	Horizontal	0,0	*	0,0	*	0,40	*	56	or	36	=	0	or	0

Solar heating power P_S

Total = 3840 or 2213

Internal heating load P_I

Spec. Power W/m² 1,6 * A_{TFA} m² 1303 = P_I 1: 2086 W or P_I 2: 2086 W

Heating power (gains) P_G

P_G 1 W / P_G 2 W

$P_T + P_I$ = 5925 or 4298

$P_L - P_G$ = 136976 or 116915

Heating load P_H

= 136976 W

Area specific space heating load PH / A_{TFA}

= 105,1 W/m²

Input Max. Supply Air Temperature 52 °C

Max. Supply Air Temperature $\vartheta_{Supply,Max}$ 52 °C — Supply Air Temperature Without Heating $\vartheta_{Supply,Min}$: °C -9,1 / °C -4,6

For comparison: heating load transportable by the supply Air. $P_{Supply\ Air,Max}$

= 13748 W specific: 10,5 W/m²

Supply Air Heating Sufficient? (Yes/No) no

EnerPHit planning:

SUMMER VENTILATION

Building:	School "Tzanko Diustabanov"-Block A		Building type:	School	
Building volume:	3259	m³	Heat recovery η_{HRV}:	0%	
Max. indoor absolute humidity:	12	g/kg	Energy recovery η_{ER}:	0%	
Internal humidity sources:	2	g/(m²h)	Subsoil heat exchanger η^*_{SHX}:	0%	

Results passive cooling			**Results active cooling**		
Frequency of overheating:	9,6%	at the overheating limit ϑ_{max} = 25 °C	Useful Cooling Demand:	10,3	kWh/(m²a)
Frequency of exceeded humidity:	0,0%		Dehumidification demand:	0,4	kWh/(m²a)
max. humidity:	11,7	g/kg			

Summer background ventilation to ensure adequate air quality

Air exchange via ventilation system with supply	0,00	1/h	HRV/ERV in Summer (check only one field)	
			None	
			automatic bypass, controlled by temperature difference	
			automatic bypass, controlled by enthalpy difference	
			always	
Air exchange via extract air system	0,00	1/h		
			Specific power consumption (for extract air system)	0,00 Wh/m³
Window ventilation air exchange	0,46	1/h		

Effective air exchange

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,equi,fraction}$ 1/h
exterior $n_{V,e}$	0,000	*(1-	0%	)*(1-	0,00	) =	0,000
without HR	0,000	*(1-	0%	)		=	0,000
Ground nL,g	0,000	*	0%	*(1-	0,00	) =	0,000
without HR	0,000	*	0%			=	0,000

Ventilation conductance

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)			
exterior $H_{V,e}$	3259	*	0,000	*	0,33	=	0,0	W/K
without HR	3259	*	0,000	*	0,33	=	0,0	W/K
Ground $H_{V,g}$	3259	*	0,000	*	0,33	=	0,0	W/K
without HR	3259	*	0,000	*	0,33	=	0,0	W/K
Infiltration, window, extract air system	3259	*	0,460	*	0,33	=	494,7	W/K

Additional Summer Ventilation for Cooling

Additional ventilation regulation

Minimum Acceptable Indoor Temperatur: 20,0 °C

Type of additional ventilation

Window Night Ventilation, Manual	Night ventilation value	0,40	1/h	
	Corresponding air change rate	0,00	1/h	Controlled by (please cl
mechanical, automatically	during operation, in addition to base air change			Temperature difference
Controlled ventilation	Specific power consumption	0,00	Wh/m³	Humidity difference x

Secondary Calculation: hygienic air exchange through window ventilation

Estimation for window air exchange to ensure sufficient air quality

Description								
Open duration [h/d]	2	3	1					
Climate Boundary Conditions								
Temperature Diff Interior - Exterior	4	4	4				K	
Wind Velocity	1	1	1				m/s	
Window Group 1								
Quantity	5	2	1					
Clear Width	2,15	2,40	1,90				m	
Clear Height	2,05	2,60	2,50				m	
Tilting window (check if appropriate)								
Opening Width (for tilting windows)							m	
Window Group 2 (Cross Ventilation)								
Quantity	5	2	2					
Clear Width	2,15	3,50	2,40				m	
Clear Height	1,45	2,60	2,60				m	
Tilting window (check if appropriate)								
Opening Width (for Tilting Windows)							m	
Difference in Height to Window 1							m	
							Total	
Result: air exchange	**0,13**	**0,30**	**0,07**	**0,00**	**0,00**	**0,00**	**0,50**	**1/h**

Secondary calculation: additional night ventilation for cooling

Air change value during additional window night ventilation

Description								
Reduction Factor	Night 100%	Night 100%						
Climate Boundary Conditions								
Temperature Diff Interior - Exterior	1	1	1	1	1	1	K	
Wind Velocity	0	0	0	0	0	0	m/s	
Window Group 1								
Quantity	7	4						
Clear Width	2,15	2,40					m	
Clear Height	2,05	2,60					m	
Tilting window (check if appropriate)	x	x						
Opening Width (for Tilting Window	0,060	0,060					m	
Window Group 2 (Cross Ventilation)								
Quantity	7	2						
Clear Width	2,15	3,50					m	
Clear Height	1,45	2,60					m	
Tilting window (check if appropriate)	x	x						
Opening Width (for Tilting Window	0,060	0,060					m	
Difference in Height to Window 1							m	
							Total	
Result: night ventilation values	**0,11**	**0,08**	**0,00**	**0,00**	**0,00**	**0,00**	**0,19**	**1/h**

EnerPHit planning: **SUMMER: PASSIVE COOLING**

Climate:	Велико Търнов PHI	Building type:	School
Building:	School "Tzanko Diustabanov"-Block A	Treated Floor Area A_{TFA}:	1303,5 m²
Overtemperature limit:	25 °C	Building volume:	3259 m³
Nominal humidity:	12 g/kg	Internal humidity sources:	2,0 g/(m²h)
Spec. Capacity:	204 Wh/(m²K)		

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Red. Factor $f_{T,Summer}$		H_{Summer} Heat Conductance
1.	Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	=	1820,1
2.	Exterior Wall - Ground	B		*		*	1,00	=	
3.	Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	=	1689,1
4.	Floor slab / basement ceili	B	549,8	*	2,012	*	1,00	=	1106,1
5.		A		*		*	1,00	=	
6.		A		*		*	1,00	=	
7.		X		*		*	0,75	=	
8.	Windows	A	433,8	*	2,513	*	1,00	=	1090,0
9.	Exterior Door	A	2,0	*	5,500	*	1,00	=	11,0
10.	Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	=	-128,7
11.	Perimeter TB (length/m)	P	110,2	*	-0,380	*	1,00	=	-41,8
12.	Ground TB (length/m)	B		*		*	1,00	=	

Exterior Thermal Transmittance, $H_{T,e}$ 4481,6 W/K

Ground Thermal Transmittance, $H_{T,g}$ 1064,3 W/K

Summer Ventilation

from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	0,0	W/K
without HR	0,0	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	494,7	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	20,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	0,00	1/h
Ambient air exchange	0,46	1/h
Window night ventilation air exchange rate, manual @ 1K	0,40	1/h
Air change rate due to mechanical, automatically controlled ventilation	0,00	1/h
Specific power consumption for	0,00	Wh/m³
η_{HR}		
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

	Orientation of the area	Angle Factor Summer		Shading Factor Summer		Loss-Dirt		g-Value (perp. radiation)		Area m²		Portion of Glazing	=	Aperture m²
1.	North	0,9	*	0,68	*	0,95	*	0,77	*	52,7	*	52%	=	12,1
2.	East	0,9	*	0,70	*	0,95	*	0,77	*	242,4	*	48%	=	54,2
3.	South	0,9	*	0,64	*	0,95	*	0,81	*	36,9	*	55%	=	9,0
4.	West	0,9	*	0,83	*	0,95	*	0,77	*	101,7	*	48%	=	26,6
5.	Horizontal	0,9	*	1,00	*	0,95	*	0,00	*	0,0	*	0%	=	0,0
6	Sum opaque areas													57,6

Solar Aperture Total 159,5 m²/m² 0,12

Internal Heat Gains Q_I

Specif. Power q_I W/m²		A_{TFA} m²	=	W	W/m²
2,8	*	1303	=	3650	2,8

Frequency of Overheating $h_{\vartheta \geq \vartheta max}$ **9,6%** **At the overheating limit ϑ_{max} = 25 °C**

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

Daily internal temperature stroke

Transmission kWh/d		Ventilation kWh/d		Solar load kWh/d		1/k		Spec. Capacity Wh/(m²K)		A_{TFA} m²			
(602,3	+	118,0	+	828,0	) *	1000	/ (	204	*	1303	) =	5,8	K

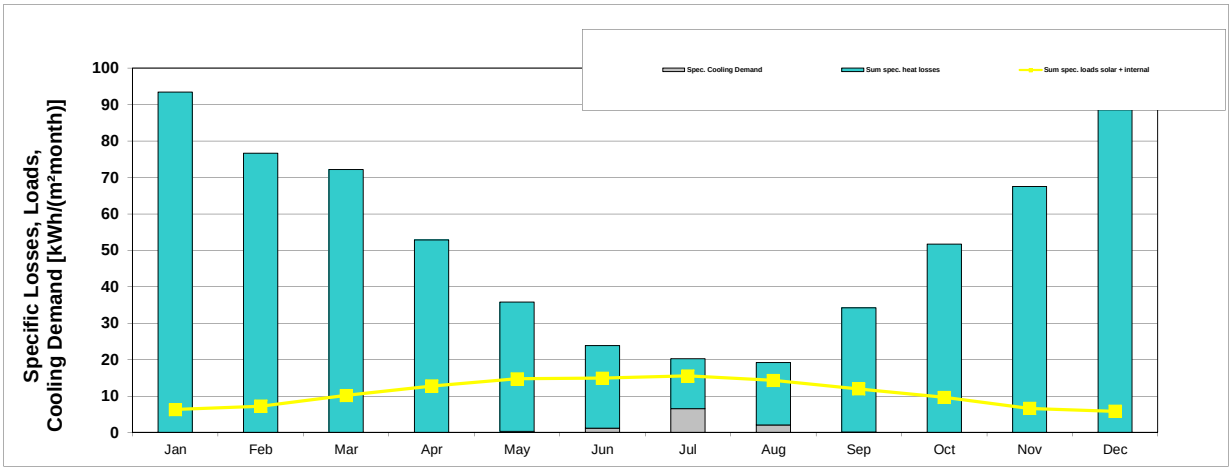
EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

Climate: Велико Търнов PHI
Building: School "Tzanko Diustabanov"-Block A

Interior Temperature: 25 °C
Building type: School
Treated Floor Area A_{TFA}: 1303 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	19,4	15,9	14,9	10,8	7,1	4,3	2,8	3,1	6,9	10,7	14,0	18,8	129	kKh
Heating Degree Hours - Ground	5,4	4,9	5,4	5,0	4,9	4,5	1,4	4,3	4,3	4,6	4,8	5,2	55	kKh
Losses - Exterior	95614	78351	73546	53340	34732	20932	13734	14860	33727	52425	69075	92507	632845	kWh
Losses - Ground	5985	5471	5961	5538	5406	4931	1551	4804	4742	5138	5279	5765	60570	kWh
Losses summer ventilation	20197	16115	14503	9898	6054	3608	2603	2643	5925	9753	13697	19435	124431	kWh
Sum spec. heat losses	93,4	76,7	72,1	52,8	35,4	22,6	13,7	17,1	34,1	51,6	67,6	90,3	627,4	kWh/m²
Solar load North	170	231	340	449	583	656	619	534	389	291	182	158	4602	kWh
Solar load East	1940	2321	3385	4553	5238	5306	5512	4961	4175	3241	1977	1717	44325	kWh
Solar load South	551	615	768	814	777	732	786	841	868	823	588	515	8678	kWh
Solar load West	717	930	1541	1966	2391	2391	2524	2365	1913	1435	824	611	19607	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	2133	2856	4489	6183	7488	7708	8079	7199	5636	4069	2380	1882	60103	kWh
Internal Heat Gains	2715	2453	2715	2628	2715	2628	2715	2715	2628	2715	2628	2715	31971	kWh
Sum spec. loads solar + internal	6,3	7,2	10,2	12,7	14,7	14,9	15,5	14,3	12,0	9,6	6,6	5,8	129,9	kWh/m²
Utilisation Factor Losses	7%	9%	14%	24%	41%	61%	65%	71%	35%	19%	10%	6%	19%	
Useful Cooling Energy Demand	0	1	7	58	408	1577	8520	2677	194	18	1	0	13461	kWh
Spec. Cooling Demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,3**	**1,2**	**6,5**	**2,1**	**0,1**	**0,0**	**0,0**	**0,0**	**10,3**	kWh/m²
specif. dehumidification demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	**0,1**	**0,0**	**0,0**	**0,0**	**0,0**	**0,4**	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	96%	94%	100%	100%	100%	100%	96%	



EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

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

Climate: Велико Търнов PHI
Building: School "Tzanko Diustabanov"-Block A
Interior temperature summer: 25 °C
Nominal humidity: 12 g/kg
Spec. Capacity: 204 Wh/(m²K)

Building type: School
Treated Floor Area A_{TFA}: 1303,5 m²
Building volume: 3259 m³
Internal humidity sources: 2,0 g/(m²h)

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Mon. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
1.	Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	*	129	=	234085	179,59
2.	Exterior Wall - Ground	B		*		*	1,00	*		=		
3.	Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	*	129	=	217245	166,67
4.	Floor slab / basement c	B	549,8	*	2,012	*	1,00	*	55	=	60570	46,47
5.		A		*		*	1,00	*		=		
6.		A		*		*	1,00	*		=		
7.		X		*		*	0,75	*		=		
8.	Windows	A	433,8	*	2,513	*	1,00	*	129	=	140192	107,55
9.	Exterior Door	A	2,0	*	5,500	*	1,00	*	129	=	1415	1,09
10.	Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	*	129	=	-16548	-12,70
11.	Perimeter TB (length/m)	P	110,2	*	-0,380	*	1,00	*	129	=	-5380	-4,13
12.	Ground TB (length/m)	B		*		*	1,00	*		=		0,00

Transmission losses Q_T (negative: heat loads) — Total: 631579 kWh/a; 484,5 kWh/(m²a)

Summer Ventilation from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	0,0	W/K
without HR	0,0	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	494,7	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	20,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	0,00	1/h
Ambient air exchange	0,46	1/h
Window night ventilation air exchange rate, manual @ 1K	0,40	1/h
Air change rate due to mechanical, automatically controlled v	0,00	1/h
Specific power consumption for	0,00	Wh/m³
η_{HR}	0%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

Hygienic air change

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{V,e}$	0,000	*(1-	0%	)*(1-	0,00	)+	0,460	=	0,460
Effective Air Change Rate Ground $n_{V,g}$	0,000	*	0%	*(1-	0,00	)		=	0,000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	3259	*	0,460	*	0,33	*	125	=	61837	47,4
Ventilation losses ground $Q_{V,e}$	3259	*	0,000	*	0,33	*	0	=	0	0,0
Heat losses summer ventilation	3259	*	0,677	*	0,33	*	171	=	124431	95,5

Ventilation heat losses Q_V — Total: 186267 kWh/a; 142,9 kWh/(m²a)

	Q_T kWh/a		Q_V kWh/a		kWh/a	kWh/(m²a)
Total heat losses Q_L	631579	+	186267	=	817846	627,4

	Orientation of the area	Reduction Factor		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
1.	North	0,30	*	0,77	*	52,7	*	379	=	4602
2.	East	0,29	*	0,77	*	242,4	*	818	=	44325
3.	South	0,30	*	0,81	*	36,9	*	960	=	8678
4.	West	0,34	*	0,77	*	101,7	*	738	=	19607
5.	Horizontal	0,40	*	0,00	*	0,0	*	1299	=	0
6.	Sum opaque areas									60103

Available Solar Heat Gains Q_S — Total: 137315 kWh/a; 105,3 kWh/(m²a)

	kh/d		Length Heat. Period d/a		Spec. Power q_i W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
Internal Heat Gains Q_I	0,024	*	365	*	2,8	*	1303,5	=	31971	24,5

	kWh/a	kWh/(m²a)
Sum heat loads Q_F (Q_S + Q_I)	169286	129,9
Ratio of Losses to Free Heat Gains (Q_L / Q_F)	4,83	
Utilisation Factor Heat Losses η_G	19%	
Useful heat losses $Q_{V,n}$ (η_G * Q_L)	155825	119,5
Useful Cooling Demand Q_K (Q_F - $Q_{V,n}$)	13461	**10**

Limiting value 15 kWh/(m²a)

Requirement met? - (Yes/No)

EnerPHit planning: # COMPRESSOR COOLING UNITS

Climate:	Велико Търнов PHI		Building type:	School	
Building:	School "Tzanko Diustabanov"-Block A		Treated Floor Area A_{TFA}:	1303,5	m²
Interior temperature summer:	25,0	°C	Mechanical cooling:		
Nominal humidity:	12,0	g/kg	Air exchange via ventilation system with supply air:	0,0	
Internal humidity sources:	2,0	g/(m²h)			

Supply Air Cooling
check as appropriate

On/Off Mode (check as appropriate)		
max. cooling capacity (sensible + latent)		kW
Temperature reduction dry		K
Seasonal energy efficiency ratio	2,0	

Recirculation Cooling
check as appropriate

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

Additional Dehumidification
check as appropriate

Waste heat to room (please check if applicable)		
Seasonal energy efficiency ratio		

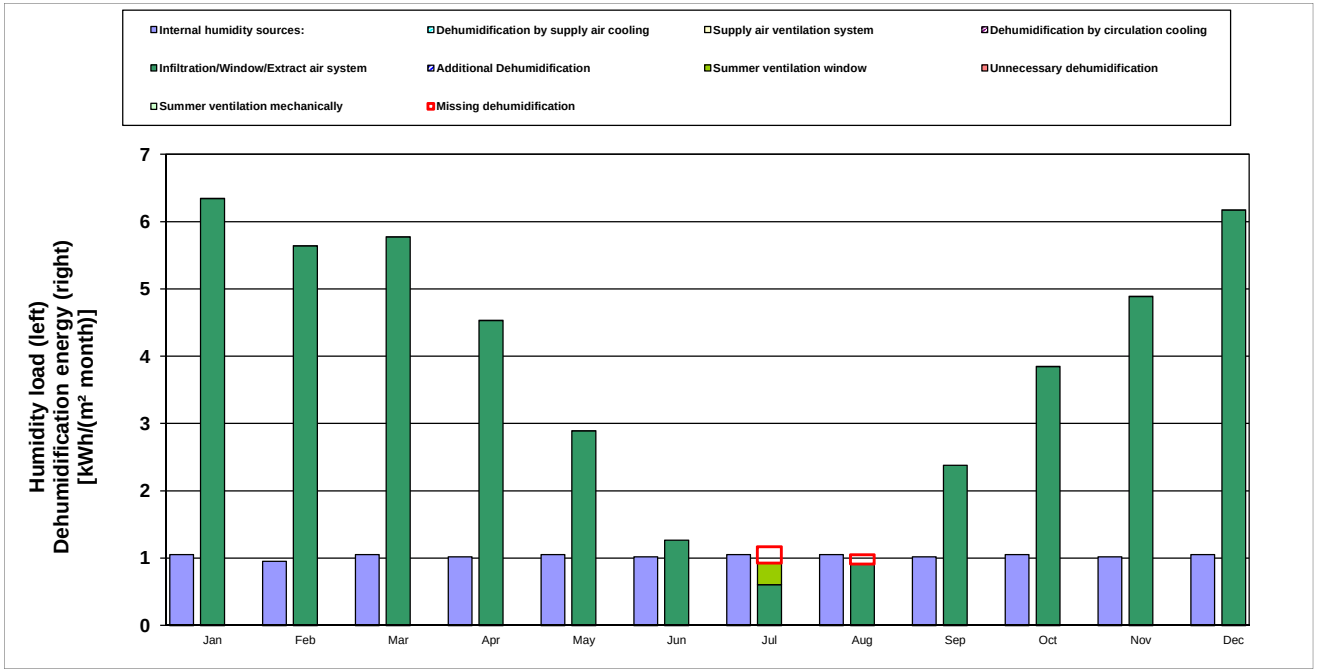
Panel Cooling
check as appropriate

Seasonal energy efficiency ratio		

	sensible kWh/(m²a)		latent kWh/(m²a)		COP		lectricity Demand (kWh/a) kWh/(m²a)	Sensible Fraction
Useful cooling total	10,3		0,4					96%
Cooling contribution by:								
Supply Air Cooling	(	+		) /	2,0	=		
Recirculation Cooling	(	+		) /	0,0	=		
Dehumidification				/		=		0%
Remaining for Panel Cooling				/	0,0	=		100%
Total	(0,0	+	0,0	) /		=	0,0	0%
Unsatisfied Demand	10,3		0,4				**Cooling demand covered?** (Yes/No)	

Humidity loads and humidity removal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Internal humidity sources:	1,1	1,0	1,1	1,0	1,1	1,0	1,1	1,1	1,0	1,1	1,0	1,1	12	kWh/m²
Infiltration/Window/Extract air system	-6,3	-5,6	-5,8	-4,5	-2,9	-1,3	-0,6	-0,9	-2,4	-3,8	-4,9	-6,2	-45	kWh/m²
Supply air ventilation system	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Summer ventilation window	0,0	0,0	0,0	0,0	0,0	0,0	-0,3	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Summer ventilation mechanically	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Total humidity load	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,0	0,0	0,0	0	kWh/m²
Dehumidification by supply air cooling	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Dehumidification by circulation cooling	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Additional Dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Total dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	
Unnecessary dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Missing dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0	kWh



EnerPHit planning: **COOLING LOAD**

Building: School "Tzanko Diustabanov"-Block A
Climate (HL): Велико Търнов PHI

Building type: School
Treated Floor Area A_{TFA}: 1303,5 m²
Building volume: 3259 m³
Interior Temperature: 25 °C
Spec. Capacity: 204 Wh/(m²
Nominal humidity: 12,0 g/kg
Internal humidity sources: 2,0 g/kg

Temperature:	Ambient Air		Dew Point	Sky	
Weather 1:	28,1	°C	18,6	16,5	°C
Weather 2:	24,5	°C	18,6	18,6	°C
Ground Design Temp.	23,2	°C	SHX	11,7	°C

Radiation:	North	East	South	West	Horizontal	
	92	197	185	197	349	W/m²
	64	159	237	159	269	W/m²

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	1365,6	*	1,333	*	1,00	*	3,1	or	-0,5	=	5697	or	-855
2.	Exterior Wall - Ground	B		*		*	1,00	*	-1,8	or	-1,8	=		or	
3.	Roof/Ceiling - Ambient	A	549,8	*	3,072	*	1,00	*	3,1	or	-0,5	=	5287	or	-794
4.	Floor slab / basement ceiling	B	549,8	*	2,012	*	1,00	*	-1,8	or	-1,8	=	-1989	or	-1989
5.		A		*		*	1,00	*	3,1	or	-0,5	=		or	
6.		A		*		*	1,00	*	3,1	or	-0,5	=		or	
7.		X		*		*	0,75	*	3,1	or	-0,5	=		or	
8.	Windows	A	433,8	*	2,513	*	1,00	*	3,1	or	-0,5	=	3412	or	-512
9.	Exterior Door	A	2,0	*	5,500	*	1,00	*	3,1	or	-0,5	=	34	or	-5
10.	Exterior TB (length/m)	A	597,1	*	-0,215	*	1,00	*	3,1	or	-0,5	=	-403	or	60
11.	Perimeter TB (length/m)	P	110,2	*	-0,380	*	1,00	*	-1,8	or	-1,8	=	75	or	75
12.	Ground TB (length/m)	B		*		*	1,00	*	-1,8	or	-1,8	=		or	
13.	House/DU Partition Wall	I	70,1	*	1,347	*	1,00	*	3,0	or	3,0	=	283	or	283
14.	Radiation correction ambient air				$L_{ambient}$ W/K		-379,1	*	3,1	or	-0,5	=	-1187	or	178
15.	Radiation correction sky				L_{Sky} W/K		295,5	*	-8,5	or	-6,4	=	-2503	or	-1891

Transmission heat load P_T Total = 8707 or -5450

Ventilation load	V_V m³		$n_{V,equi,fraction}$ 1/h		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
Exterior $P_{V,e}$	3259	*	0,460	or	0,460	*	0,33	*	3,1	or	-0,5	=	1548	or	-232
Ground PL,e	3259	*	0,000	or	0,000	*	0,33	*	-13,3	or	-13,3	=	0	or	0
Summer ventilation $P_{L,S}$	3259	*	0,000	or	0,000	*	0,33	*	0,0	or	0,0	=	0	or	0

Ventilation heat load P_V Total = 1548 or -232

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	52,7	*	0,8	*	0,30	*	92	or	64	=	1117	or	771
2.	East	242,4	*	0,8	*	0,29	*	198	or	179	=	10744	or	9709
3.	South	36,9	*	0,8	*	0,30	*	185	or	237	=	1672	or	2138
4.	West	101,7	*	0,8	*	0,34	*	197	or	159	=	5234	or	4212
5.	Horizontal	0,0	*	0,0	*	0,40	*	349	or	269	=	0	or	0
6.	Sum opaque areas											15735	or	12595

Solar load P_S Total = 34502 or 29426

Internal heating load P_I Spec. Power W/m² = 2,8 * A_{TFA} m² = 1303 = P_I 1: 3650 W or P_I 2: 3650 W

$P_T + P_V + P_S + P_I$ = 48407 or 27393

Cooling load P_C = 48407 W

Area specific cooling load P_C / A_{TFA} = 37,1 W/m²

Please enter the minimum supply air temperature. 3 °C

Supply air temperature without cooling $\vartheta_{Supply,Min}$ °C: 28,1 or 24,5 °C

For comparison: cooling load, transportable through the supply air $P_{Supply;Max}$ = 0 W or 0 W
specific: 0,0 W/m² or 0,0 W/m²

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

Daily internal temperature stroke

(Transmission 8707,2 W + Ventilation 1548,3 W + Solar load 34501,6 W) * Time 24 h/d / (Spec. Capacity 204 Wh/(m²K) * A_{TFA} 1303 m²) = 4,0 K

Attention: high daily temperature swings. The consideration of a daily average cooling load is not sufficient. If appropriate, improve solar shading!

Dehumidification load from 'Cooling' worksheet

Absolute humidity exterior air	13,4	or	13,4	g/kg	Absolute humidity supply air	13,4	or	13,4	g/kg
Ambient air mass flow	1769	or	1769	kg/h	Supply air mass flow	0	or	0	kg/h
Summer ventilation air mass flow	0	or	0	kg/h	**Humidity load, supply air**	0	or	0	g/h
Humidity load, outside air	2553	or	2553	g/h	**Humidity load, internal**	2607	or	2607	g/h

Enthalpy of vaporisation Wh/kg: 707,639 / g/kg: 1000 * Humidity load g/h: 5160 or Humidity load g/h: 5160 = P_D 1: 3652 W or P_D 2: 3652 W

Dehumidification load P_T = 3652 W

Area specific dehumidification load P_T / A_{TFA} = 2,8 W/m²

Monthly Average values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Spec. Cooling Demand	0,0	0,0	0,0	0,0	0,3	1,2	6,5	2,1	0,1	0,0	0,0	0,0	kWh/m²
Specif. dehumidification demand	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0	0,0	0,0	0,0	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	96%	94%	100%	100%	100%	100%	

Minimum of sensible cooling load fraction occurred 100%

HEAT DISTRIBUTION AND DHW SYSTEM

Building: School "Tzanko Diustabanov"-Block A

Interior Temperature:	20	°C
Building type:	School	
Treated Floor Area A_{TFA}:	1303	m²
Occupancy:	225,0	Pers
Number of dwelling units:	1	
Annual heating demand qHeating	325942	kWh/a
Length of Heating Period:	189	d
Average heating load Pave:	71,8	kW
Marginal Utilisability of Additional Heat Gains:	100%	

Parts

			Warm region	Cold Region		Total		
Space Heat Distribution			1	2	3			
Length of Distribution Pipes	L_H *(Project)*		10,00	12,00			m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,362	0,362			W/(mK)	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		20	10,0			°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		55,0	56,0			°C	
Design system heating load	$P_{heating}$ *(exist./calc.)*		137,0	137,0			kW	
Flow Temperature Control (check)			x					
Design Return Temperature	ϑ_R	=0.714*(J_{dist}-20)+20	45,0	45,7			°C	
Annual Heat Emission per m of Plumbing	q^*_{HL}	= Y (J_m−ϑ_X) $t_{Heating}$*0.024	30	67			kWh/(m·a)	
Possible Utilization Factor of Released Heat	η_G		100%	0%			-	
Annual Losses	Q_{HL}	= L_H · q^*_{HL} · (1-η_G)	0	806	0	806	kWh/a	
Specif. losses	q_{HL}	= ΣQ_{HL} / A_{TFA}					kWh/(m²a)	0,6
'Performance ratio of heat distribution	$e_{a,HL}$	= (q_H + q_{HV}) / q_H				100%	-	

DHW: Standard Useful Heat

DHW Consumption per Person and Day (60 °C)	V_{DHW} *(Project or Average Value 25 Litres/P/d)*		3,0	Litre/Person/d
Average Cold Water Temperature of the Supply	ϑ_{DW} *Temperature of drinking water*		11,7	°C
DHW Non-Electric Wash and Dish	*(Electricity worksheet)*		0	kWh/a
Useful heat - DHW	Q_{DHW}		13810	kWh/a
Specif. useful heat - DHW	q_{DHW}	= Q_{DHW} / A_{TFA}		kWh/(m²a) 10,6

DHW Distribution and Storage			Warm region	Cold Region		Total		
Length of Circulation Pipes (Flow + Return)	L_{HS} *(Project)*		15,0	10,0			m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,780	0,780			W/m/K	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		20	10,0			°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		60,0	60,0			°C	
Daily circulation period of operation.	td_{Circ} *(Project)*		10,0	10,0			h/d	
Design Return Temperature	ϑ_R	=0.875*(ϑ_{dist}-20)+20	55	55			°C	
Circulation period of operation per year	t_{Circ}	= 365 td_{Circ}	3650	3650			h/a	
Annual Heat Released per m of Pipe	q^*_z	= Y (J_m−ϑ_X) t_{Circ}	107	135			kWh/m/a	
Possible Utilization Factor of Released Heat	η_{GDHW}	=$t_{heating}$/365d * η_G	52%	0%			-	
Annual Heat Loss from Circulation Lines	Q_Z	= L_{HS} · q^*_Z ·(1-η_{GDHW})	772	1352		2124	kWh/a	
Total length of individual pipes	L_U *(Project)*		10,00				m	
Exterior pipe diameter	d_{U_Pipe} *(Project)*		0,030				m	
Tap openings per person per day			3	3	3		-	
Utilisation days per year			365	365	365		d	
Heat loss per tap opening	$q_{Individual}$	=($c_{pH2O}V_{H2O}$+$c_{pMat}V_{Mat}$)(ϑ_{dist}-ϑ_X)	0,2805				kWh/tap opening	
Amount of tap openings per year	n_{Tap}	= n_{Pers} · n_{Tap} · d / n_{WE}	246375				Tap openings per year	
Annual Heat Loss	q_U	= n_{Tap} · $q_{Individual}$	69111				kWh/a	
Possible Utilization Factor of Released Heat	η_{G_U}	=$t_{heating}$/8760*η_G	52%				-	
Annual Heat Loss of individual pipes	Q_U	= q_U ·(1-η_{G_U})	33296			33296	kWh/a	
Average Heat Released from storage	P_S		150				W	
Possible Utilization Factor of Released Heat	η_{G_S}	=$t_{heating}$/8760*η_G	52%					
Annual Heat Losses from storage	Q_S	= P_S·8.760 kh·(1-η_{G_S})	633			633	kWh/a	
Total heat losses of the DHW system	Q_{WL}	= Q_Z+Q_U+Q_S				36053	kWh/a	
Specif. losses of the DHW system	q_{WL}	= Q_{WL} / A_{TFA}					kWh/(m²a)	27,7
Performance ratio DHW-distribution + storage	$e_{a,WL}$	= (q_{TDHW} + q_{WV}) / q_{TDHW}				361%	-	
Total heating demand of DHW system	Q_{gDHW}	= Q_{DHW}+Q_{WL}				49863	kWh/a	
Totalspec. heating demand of DHW system	q_{gDHW}	= Q_{gDHW} / A_{TFA}					kWh/(m²a)	38,3

Secondary calculation: Ψ-values of plumbing

Nominal width:	25	mm
Insulation Thickness:	50	mm
Mirrored?		Yes
	x	No
Thermal Conductivity	0,040	W/(mK)
Δϑ	30	K
Interior Pipe Diameter:	0,025	m
Exterior Pipe Diameter	0,027	m
Exterior Pipe Diameter	0,127	m
α–Surface	6,08	W/(m²K)
Ψ-Value	**0,153**	**W/(mK)**
Surface Temperature Difference	1,886	K

EnerPHit planning:

SOLAR THERMAL SYSTEM

Building: School "Tzanko Diustabanov"-Block A

Building type: School

Treated Floor Area A_{TFA}: 1303,5 m²

Solar fraction

Heating Demand DHW	q_{gDHW}	49863	kWh/a	*(DHW+Distribution)*
Annual heating demand		326747	kWh/a	*(Worksheets Heating & DHW+Distribution)*
Heating support (please check, if applicable)				
DHW priority (check if appropriate)				
Latitude:		43,1	°	*(Worksheet Climate)*

Collector: 7 Improved flat plate collector

Solar Collector Area		0,00	m²
Deviation from North		180	°
Angle of Inclination from the Horizontal		45	°
Height of the Collector Field		1,00	m
Height of Horizon	h_{Hori}		m
Horizontal Distance	a_{Hori}		m
Additional Reduction Factor Shading	r_{other}		

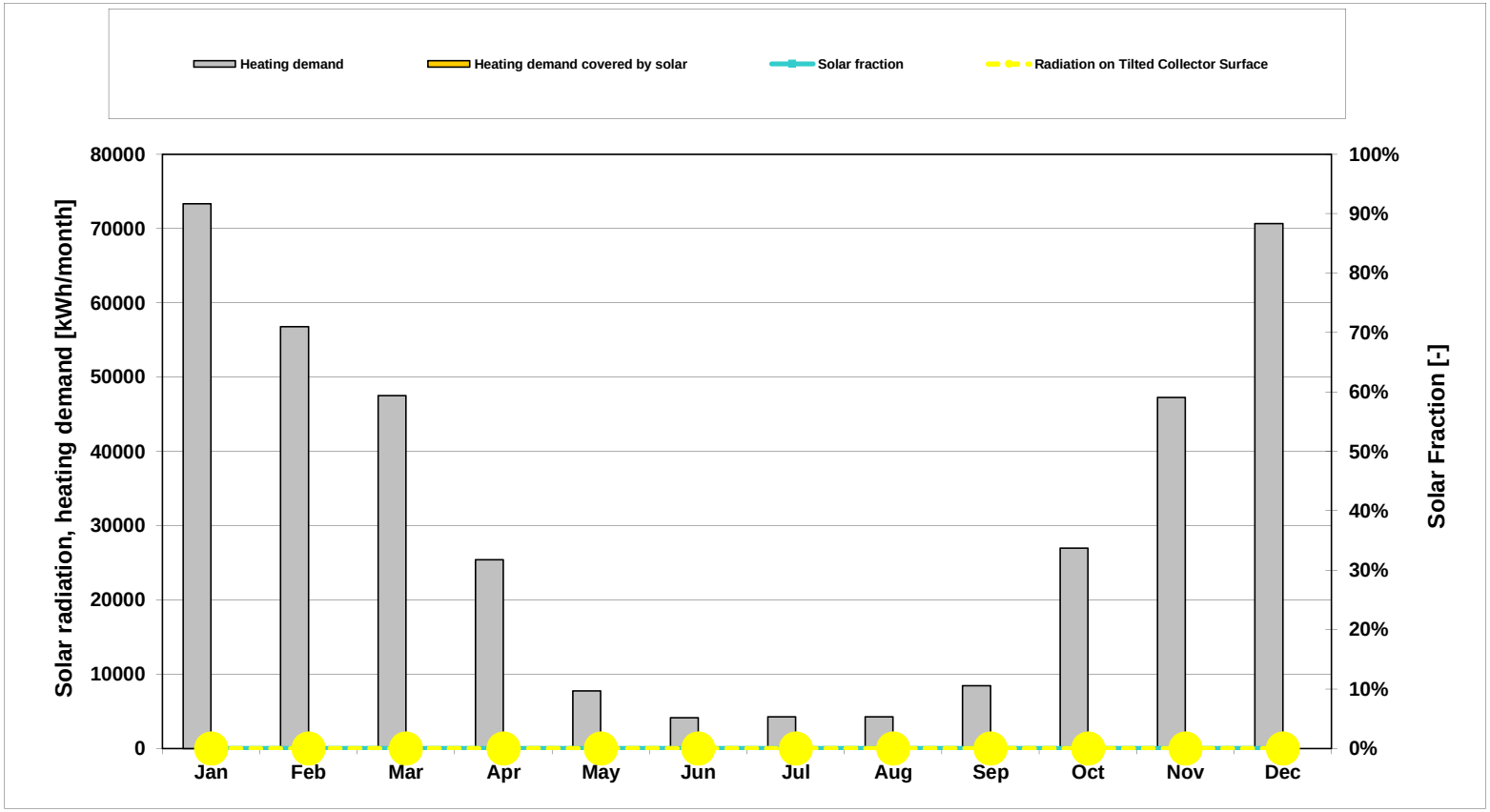
Occupancy	225,0	Persons
Specific Collector Area	0,0	m²/Pers

Estimated solar DHW fraction	**0%**	**0**	kWh/a	**0**	kWh/(m²a)
Estimated solar coverage for heating	**0%**	**0**	kWh/a	**0**	kWh/(m²a)
Solar heat contribution total	**0%**	**0**	kWh/a	**0**	kWh/(m²a)

Secondary Calculation of Storage Losses

Solar Storage: 9 Simple solar storage

Total storage volume		500	litre
Volume Standby Part (above)		150	litre
Volume Solar Part (below)		350	litre
Specific heat losses storage (total)		3,6	W/K
Typical Temperature DHW		60	°C
Room Temperature		10	°C
Storage heat losses (standby part only)		**38**	W
Total storage heat losses		**180**	W



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating demand DHW-preparation	4235	3825	4235	4098	4235	4098	4235	4235	4098	4235	4098	4235	49863	kWh/month
Heating demand space heating	69090	52942	43257	21298	3505	14	0	0	4342	22737	43133	66430	326747	kWh/month
Heating demand	73325	56768	47492	25396	7739	4112	4235	4235	8441	26972	47231	70664	376610	kWh/month
Radiation on Tilted Collector Surface	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Please enter: Solar production for DHW													0	kWh/month
Please enter: Solar production for heating													0	kWh/month
DHW heat demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Heating demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Heating demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Solar fraction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-

Hit planning:

PHOTOVOLTAIC SYSTEM

Building: School "Tzanko Diustabanov"-Block A

Climate: Велико Търнов PHI

Building type: School

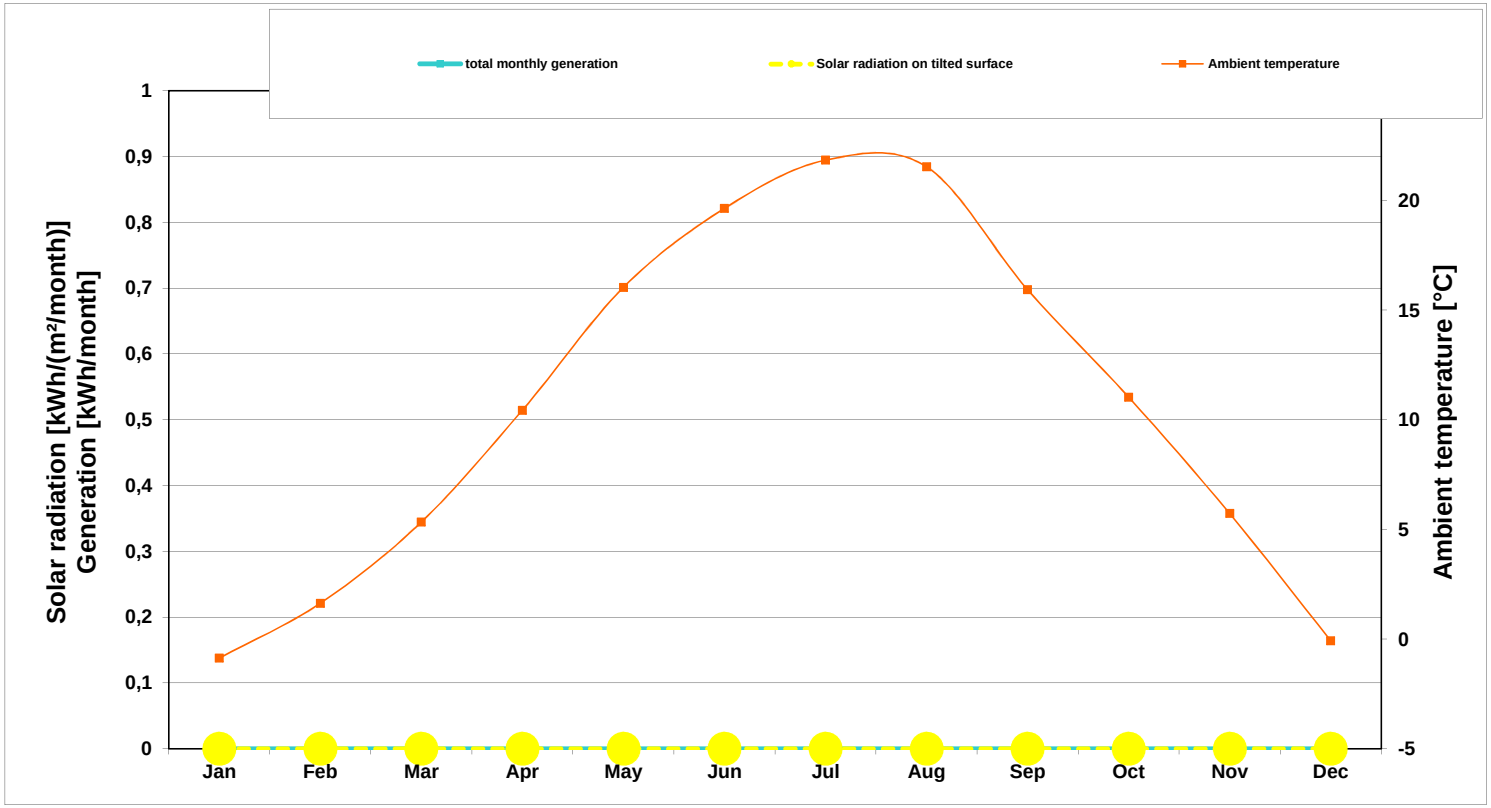
Information from the module data sheet

Technology	Amorph-Si		
Nominal current	I_{MPP0}		A
Nominal voltage	U_{MPP0}		V
Nominal power	P_n	0	W_p
Temperature coefficient short-circuit current	α		%/K
Temperature coefficient open-circuit voltage	β		%/K

Further specifications

Latitude:		43,1	°	*(Worksheet Climate)*
Number of modules	n_M			
Deviation from North			°	
Angle of inclination from the horizontal			°	
Height of module array			m	
Height of horizon	h_{Hori}		m	
Horizontal distance	a_{Hori}		m	
Additional Reduction Factor Shading	r_{other}			
Efficiency of the inverter	η_{HRV}			

Annual yield of the inverter		kWh
Annual losses due to shading		kWh
PE value (non-renewable)		
CO_2-equivalent emission value		g/kWh



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Year	
Solar radiation on tilted surface													kWh/m²/Month		kWh/m²/a
Ambient temperature	-1	2	5	10	16	20	22	22	16	11	6	0	°C	10,7	°C
total monthly generation													kWh/month		kWh/a
Losses due to shading situation													kWh/month		kWh/a

EnerPHit planning: **ELECTRICITY DEMAND**

Building: School "Tzanko Diustabanov"-Block A

Calculation in worksheet 'Electricity non-res'!

Households	1	HH
Persons	225,0	P
Living Area	1303	m²
Annual heating demand	250	kWh/(m²a)

Solar fraction of DHW Laundry&Dish	
Marginal Performance Ratio DHW	111%
Marginal Performance Ratio Heating	111%

Prim. Energy Factors:			
Electricity	2,6	kWh/kWh	
Natural Gas	1,1	kWh/kWh	
Energy Carrier for Space Heating/DHW:	0,8	0,8	

Column Nr.	1	2	3			4		5		6		7		8	8a		9		10		11		12		13		14
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand			Utilization Factor		Frequency		Reference Quantity		Useful Energy (kWh/a)		Electric Fraction	Non-Electric Fraction		**Electricity Demand (kWh/a)**		Additional demand		Marginal Performance Ratio		Solar Fraction		Non-Electric Demand (kWh/a)		**Primary Energy-Demand (kWh/a)**
Dishwashing	1	1	1,10	kWh/Use		1,00	*	65	/(P*a)	####	P	16088	*	100%		=	16088										41828
Cold water connection													*		0%	=		* (1+	0,30	) *	1,11	*(1-		) =			
Clothes washing	1	1	1,10	kWh/Use		1,00	*	57	/(P*a)	####	P	14108	*	100%		=	14108										36680
Cold water connection													*		0%	=		* (1+	0,05	) *	1,11	*(1-		) =			
Clothes drying with:	1	1	3,50	kWh/Use	Residual dampness	0,88	*	57	/(P*a)	####	P	39277		100%		=	39277										102119
Condensation Dryer					0,60							0			0%	=					1,00	*			0		0
Energy consumed by evaporation	0	1	3,13	kWh/Use		0,60	*	57	/(P*a)	####	P	0	*	100%		=		* (1+	0,00	) *	1,11	*(1-	0,40	) =	0		0
Refrigerating	1	1	0,78	kWh/d		1,00	*	365	d/a	1	HH	285	*	100%		=	285										740
Freezing	1	0	0,88	kWh/d		0,90	*	365	d/a	1	HH	289	*	100%		=	289										752
or combination	0	1	1,00	kWh/d		1,00	*	365	d/a	1	HH	0	*	100%		=	0										0
Cooking with:	1	1	0,25	kWh/Use		1,00	*	500	/(P*a)	####	P	28125	*	100%		=	28125										73125
Electricity					Percentage CFLs								*		0%	=									0		0
Lighting	1	1	60	W	0%	1,00	*	2,90	kh/(P*a)	####	P	39150	*	100%		=	39150										101790
Consumer electronics	1	1	80	W		1,00	*	0,55	kh/(P*a)	####	P	9900	*	100%		=	9900										25740
Small appliances, etc.	1	1	50	kWh		1,00	*	1,00	/(P*a)	####	P	11250	*	100%		=	11250										29250
Total aux. electricity												1294					1294										3366
Other:																											
				kWh/a								0					0										0
				kWh/a								0					0										0
				kWh/a								0					0										0
Total												#####	**kWh**				159765	kWh	DHW Non-Electric - Wash&Dish 0	kWh					0		415388
Specific Demand																	122,6	kWh/(m²a)	Non-Renewable Non-Electric DHW Wash&Dish 0,0	kWh/(m²a)					0,0		318,7
Recommended maximum value																	18										50

EnerPHit planning: **U T I L I S A T I O N non-residential Use**

Building: School "Tzanko Diustabanov"-Block A

Latitude [°]: 43

	Utilisation Pattern	Periods of utilisation and operation	Begin Utilisation [h]	End Utilisation [h]	Daily Utilisation Hours [h/d]	Annual Utilisation Days [d/a]	Annual Utilisation Hours [h/a]	Annual Utilisation Hours During Daytime [h/a]	Annual Utilisation Hours During Nighttime [h/a]	Daily operating hours of heating	Daily operating hours of ventilation	Lighting	Illumination Level [lux]	Height of utilisation level (0.8 or 0.0 m)	Height of utilisation level (0.8 or 0.0 m)	Relative Absenteeism	Part Use Factor of Building Operating Period for Lighting	Average Occupancy [m²/Pers.]
1	**Classroom**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,25**	**0,9**	**3,0**
2	**Corridors**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**100**	**0,0**	0,0	**0,80**	**1,0**	
3	**Lobbies**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**200**	**0,0**	0,0	**0,80**	**1,0**	
4	**Computer room**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,30**	**0,4**	**2,0**
5	**Bookstore**		**9,0**	**18**	9	**180**	1620	1534	86	11	11		**300**	**0,8**	0,8	**0,90**	**1,0**	
6	**Canteen**		**10,0**	**16**	6	**180**	990	990	0	8	8		**100**	**0,8**	0,8	**0,80**	**0,4**	
7	**Kitchen**		**10,0**	**16**	6	**180**	990	990	0	8	8		**100**	**0,8**	0,8	**0,80**	**0,4**	
8	**Stairs**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**100**	**0,0**	0,0	**0,80**	**1,0**	
9	**WC, Sanitary**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**200**	**0,8**	0,8	**0,90**	**1,0**	
10	**Teacher offices**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,30**	**0,7**	**10,0**
11					0		0	0	0	2	2				0,8			
12					0		0	0	0	2	2				0,8			
13					0		0	0	0	2	2				0,8			
14					0		0	0	0	2	2				0,8			
15					0		0	0	0	2	2				0,8			
16					0		0	0	0	2	2				0,8			
17					0		0	0	0	2	2				0,8			
18					0		0	0	0	2	2				0,8			
19					0		0	0	0	2	2				0,8			
20					0		0	0	0	2	2				0,8			
21	Single Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	10,00
22	Group Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	
23	Open-Plan Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,00	1,00	15,00
24	Meeting		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,50	1,00	2,00
25	Counter Area		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,00	1,00	
26	Retail		8	20	12	300	3600	2999	601	14			300	0,8	0,8	0,00	1,00	7,00
27	Classroom		8	15	7	200	1400	1398	2	9			300	0,8	0,8	0,25	0,90	2,00
28	University Auditorium		8	18	10	150	1500	1409	91	12			500	0,8	0,8	0,25	0,70	0,75
29	Bedroom		0	24	24	365	8760	4407	4353	24			300	0,8	0,8	0,00	0,50	
30	Hotel Room		21	8	11	365	4015	755	3260	24			200	0,8	0,8	0,25	0,30	
31	Canteen		8	15	7	250	1750	1748	2	9			200	0,8	0,8	0,00	1,00	
32	Restaurant		10	0	14	300	4200	2404	1796	16			200	0,8	0,8	0,00	1,00	1,50
33	Kitchen Non-Residential		10	23	13	300	3900	2404	1496	15			500	0,8	0,8	0,00	1,00	
34	Kitchen, Storage, Preparation		7	23	16	300	3900	2404	1496	15			300	0,8	0,8	0,50	1,00	
35	WC, Sanitary		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,90	1,00	
36	Other Habitable Rooms		7	18	11	250	2750	2543	207	13			300	0,8	0,8	0,50	1,00	
37	Secondary Areas		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,90	1,00	
38	Circulation Area		7	18	11	250	2750	2543	207	13			100	0,0	0,0	0,80	1,00	
39	Storage, Services		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,98	1,00	
40	Server Room		0	24	24	365	8760	4407	4353	24			500	0,8	0,8	0,50	0,50	
41	Workshop		7	16	9	250	2250	2192	58	11			500	0,8	0,8	0,00	1,00	
42	Theatre Auditorium		19	23	4	250	1001	55	946	6			200	0,8	0,8	0,00	1,00	
43	Theatre Foyer		19	23	4	250	1001	55	946	6			300	0,8	0,8	0,50	1,00	
44	Theatre Stage		13	23	10	250	2500	1253	1247	12			1000	0,8	0,8	0,00	0,60	
45	Fair, Congress		13	18	5	150	1350	1260	90	11			300	0,8	0,8	0,50	1,00	
46	Exhibition		10	18	8	250	2001	1850	151	24			200	0,8	0,8	0,00	1,00	
47	Library Reading Room		8	20	12	300	3600	2999	601	14			500	0,8	0,8	0,00	1,00	
48	Open Access Library		8	20	12	300	3600	2999	601	14			200	0,8	0,8	0,00	1,00	
49	Library Repository		8	20	12	300	3600	2999	601	14			100	0,8	0,8	0,90	1,00	
50	Gymnasium		8	23	15	300	4500	3002	1498	17			300	0,8	0,8	0,30	1,00	
51	Parking Garage		7	18	11	250	2750	2543	207	0			75	0,0	0,0	0,95	1,00	
52	Public Parking Garage		9	0	15	365	5475	3290	2185	0			75	0,0	0,0	0,80	1,00	

EnerPHit planning: **ELECTRICITY DEMAND Non-Residential Use**

Building: School "Tzanko Diustabanov"-Block A

Treated Floor Area A_{TFA}:	1303,5	m²
Auxiliary Electricity Demand:	1294,4	kWh/a
Primary Energy factors:		
Electricity:	2,6	kWh/kWh
Natural gas:	1,1	kWh/kWh
Energy Carrier for DHW:		kWh/kWh
Solar fraction of DHW	0%	
Marginal Performance Ratio DHW:		

Window Properties (from Windows worksheet):

	Shading	Dirt Factor	Non-Perpendicular Radiation	Glazing Fraction
North	0,63	0,95	0,85	0,52
East	0,58			0,48
South	0,75			0,55
West	0,70			0,48

Lighting / non-residential	Percentage of treated floor area	Room Category	Room Category	Nominal Illuminance Level	Facade with Windows: Deviation from North	Orientation	Light Transmission Glazing	Existing window	Room Geometry: Input of a Typical Room or Room by Room: Room Depth	Room Width	Room Height	Lintel Height	Window Width	Input Warning	Daylight Utilisation	User Data: Installed Lighting Power	Installed Lighting Power (Standard)	Lighting Control	With motion?	Lighting Control	Utilisation Hours per Year [h/a]	User Determined: Lighting Full Load Hours	Full Load Hours of Lighting	Electricity Demand (kWh/a)	Spec. Electricity Demand (kWh/(m²a))	Primary Energy Demand (kWh/a)
Room / Zone				Lux	Degrees		-	[x]	m	m	m	m	m			W/m²	W/m²		[x]		h/a	h/a	h/a	kWh/a	kWh/(m²a)	kWh/a
			2	15																	9					
Lobby	6%	3	Lobbies	200	0	North	69%		6,5	11,0	4,0	3,6	9,6		none	12	11,5			Manual Without motion	1890		1410,0	1270,3	16,2	3302,9
Lobby	6%	3	Lobbies	200	180	South	69%		6,5	11,0	4,0	3,6	8,6		none	12	11,5			Manual Without motion	1890		1410,0	1270,3	16,2	3302,9
Corridors	22%	2	Corridors	100	270	West	69%		2,6	24,0	3,4	2,5	15,6		none	7	7,4			Manual Without motion	1890		1410,0	2975,9	10,4	7737,3
Classroom east orienta	30%	1	Classroom	300	90	East	69%		5,8	7,7	3,4	3,1	6,5		none	16	15,7			Manual Without motion	1890		1566,0	9601,9	24,6	24964,9
Classroom south orient	19%	1	Classroom	300	180	South	69%		6,4	8,2	3,4	3,1	6,5		none	16	15,7			Manual Without motion	1890		1566,0	6081,2	24,6	15811,1
Classroom south orient	8%	1	Classroom	300	180	South	69%		7,0	3,0	3,4	3,1	2,2		none	16	15,7			Manual Without motion	1890		1566,0	2560,5	24,6	6657,3
WC's	9%	9	WC, Sanitary	200	90	East	69%		4,4	7,0	3,4			Contradiction: Check width and height inputs	none	12	11,5			Manual Without motion	1890		1350,0	1824,4	15,6	4743,5
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	

Office Equipment	Room Category	Room Category	In the thermal envelope? (1/0)	Existing/Planned? (1/0)	Quantity	Power Rating (W)	Utilisation Hours per Year (h/a)	relative absenteeism	Duration of Utilisation in Energy Saving Mode (h/a)	Useful Energy (kWh/a)	Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
		2					9	20 / 18				
PC 1	4	Computer room	1	1	0	55	756	0,3		0	0,0	0
PC in Energy Saving Mode			1		0	2,0	756	0,3		0	0,0	0
Monitor 1	4	Computer room	1	1	0	20	756	0,3		0	0,0	0
Monitor in Energy Saving Mode			1		0	1,5	756	0,3		0	0,0	0
PC 2	10	Teacher offices	1	1	2	55	1323	0,3		102	101,9	265
PC in Energy Saving Mode			1		2	2,0	1323	0,3		2	1,6	4
Monitor 2	10	Teacher offices	1	1	2	20	1323	0,3		37	37,0	96
Monitor in Energy Saving Mode			1		2	1,5	1323	0,3		1	1,2	3
Copier	10	Teacher offices	1	1	1	400	1890		1701	76	75,6	197
Copier in Energy Saving Mode			1		1	30	1701			51	51,0	133
Printer							0			0	0,0	0
Printer in Energy Saving Mode			0		0		0			0	0,0	0
Server							0			0	0,0	0
Server in Energy Saving Mode			0		0		8760		0	0	0,0	0
Telephone System			1	1	1	94	8760			823	823,4	2141
Hand Dryer (WC)										0	0,0	0
										0	0,0	0
										0	0,0	0
										0	0,0	0
										0	0,0	0

Kitchen / Aux. Electricity	Room Category	Predominant Utilisation Pattern of Building	In the thermal envelope? (1/0)	Existing/Planned? (1/0)	Utilisation Days per Year (d/a)	Number of Meals per Utilisation Day	Norm Consumption	Useful Energy (kWh/a)	Non-Electric Fraction	Electric Fraction	Additional demand	Marginal Performance Ratio	Solar Fraction	Other Primary Energy Demand (kWh/a)	Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
					8											
Cooking					0		0,25 kWh / Meal	0		100%					0,0	0
Electricity									0%					0		0
Dishwashing					0	0	0,10 kWh / Cover	0		55%					0,0	0
DHW connection									45%		0,30	1,20	0,00	0		0
Refrigerating					365		kWh/d	0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
Total Auxiliary Electricity								1294				Hot Water Non-Electric Dishwashing			1294,4	3366
Total								27971 kWh				0		0	27971 kWh/a	72724 kWh/a
Specific Demand												0,0		0,0	21 kWh/(m²a)	56 kWh/(m²a)

EnerPHit planning: # AUXILIARY ELECTRICITY

Building: School "Tzanko Diustabanov"-Block A

Treated Floor Area	1303	m²
Heating period	189	d
Air Volume	3259	m³
Dwelling Units	1	HH
Enclosed Volume	6224	m³

Operation Vent. System Winter	4,54	kh/a
Operation Vent. System Summer	4,22	kh/a
Air Change Rate	0,21	h^{-1}
Defrosting HX from	2,0	°C

Primary Energy factor - Electricity	2,60	kWh/kWh
Annual Space Heating Demand	250	kWh/(m²a)
Boiler Rated Power	137	kW
DHW System Heating Demand	49863	kWh/a
Design Flow Temperature	55	°C

Column Nr.	1	2	3		4		5		6		7		8		9		10		11	12
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Period of Operation		Reference Size		Electricity Demand (kWh/a)		Available as Interior Heat		Used During Time Period (kh/a)		Internal heat source Winter (W)		Internal heat source Summer (W)	Primary Energy Demand (kWh/a)
Ventilation System																				
Winter Ventilation	0		0,00	Wh/m³	* 0,21	h^{-1}	* 4,5	kh/a	* 3259	m³	= 0		considered in heat recovery efficiency							0
Defroster HX	0	1	3197	W	* 1,00		* 0,6	kh/a	* 1		= 0	*	1,0	/	4,54	=	0			0
Summer Ventilation	0	1,00	0,00	Wh/m³	* 0,00	h^{-1}	* 4,2	kh/a	* 3259	m³	= 0	*	1,0	/	4,22	=			0	0
																			Internal heat sources ' Additional summer ventilation' 0	
Additional ventilation summer	0	1,00	0,00	Wh/m³	* 0,00	h^{-1}	* 4,2	kh/a	* 3259	m³	= 0	*	1,0	/	4,22	=				0
Heating System					Controlled/UnControlled (1/0)															
Enter the Rated Power of the pump				W																
Circulation Pump	1	1	214	W	* 1,0		* 4,5	kh/a	* 1		= 973	*	1,0	/	4,54	=	214			2530
Boiler Electricity Consumption at 30% Load				W																
Aux. Energy - Heat. Boiler	0	0	159	W	* 1,00		* 0,00	kh/a	* 1		= 0	*	1,0	/	4,54	=	0			0
Aux. Energy - Wood fired/pellet boiler	0	0	Data entries in Boiler worksheet. Auxiliary energy demand including possible drinking water prod.								0	*	1,0	/	4,54	=	0			0
DHW system																				
Enter average power consumption of pump				W																
Circulation Pump	1		43	W	* 1,00		* 7,5	kh/a	* 1		= 321	*	0,5	/	8,76	=	0		0	836
Enter the Rated Power of the pump				W																
Storage Load Pump DHW			162	W	* 1,00		* 0,4	kh/a	* 1		= 0	*	1,0	/	4,54	=	0		0	0
Boiler Electricity Consumption at 100% Load				W																
DHW Boiler Aux. Energy	0	0	477	W	* 1,00		* 0,0	kh/a	* 1		= 0	*	1,0	/	4,54	=	0		0	0
Enter the Rated Power of the Solar DHW pump				W																
Solar Aux Electricity	0		130	W	* 1,00		* 1,8	kh/a	* 1		= 0	*	0,5	/	8,76	=	0		0	0
Misc. Aux. Electricity																				
Misc. Aux. Electricity				kWh/a	* 1,00		* 1,0		* 1	HH	= 0	*	1,0	/	8,76	=	0		0	0
Total											1294						214		0	3366
Specific Demand	kWh/(m²a)		divided by treated floor area:								1,0									2,6

EnerPHit planning:

INTERNAL HEAT GAINS

Building: School "Tzanko Diustabanov"-Block A

Calculation in worksheet 'IHG non-res'!

Utilisation Pattern: School — 2,80 W/m²

Type of Values Used: Standard — 18,63 W/m² in summer

No data input necessary — 1,34 W/m²

Go to utilisation pattern selection

Calculation Internal Heat Household

Persons 225,0 P

Living Area 1303 m²

Heating Demand 250 kWh/(m²a)

Heating period 189 d/a

Column Nr.		1	2	3		4	5		6		7		8		9		10
Application		Existing (1/0), or number of people	In the Thermal Envelope (1/0)	Norm Consumption		Utilization Factor	Frequency		Useful Energy (kWh/a)		Included in Electricity Balance?		Availability		Used During Time Period (kh/a)		**Internal heat source Winter (W)**
Dishwashing		1	1	1,1	kWh/Use	1,00	65	/(P*a)	16088	*			0,30	/	8,76	=	**551**
Clothes Washing		1	1	1,1	kWh/Use	1,00	57	/(P*a)	14108	*			0,30	/	8,76	=	**483**
Clothes drying with:		1	1	3,5	kWh/Use	0,88	57	/(P*a)	39277	*			0,70	/	8,76	=	**3139**
Condensation Dryer			1	0,0					0				0,80				
Energy consumed by evaporation		0	1	-3,1	kWh/Use	0,60	57	/(P*a)	0	* (1-	0	) *	0,00	/	8,76	=	**0**
Refrigerating		1	1	0,8	kWh/d	1,00	365	d/a	285	*			1,00	/	8,76	=	**33**
Freezing		1	0	0,9	kWh/d	0,90	365	d/a	289	*			1,00	/	8,76	=	**0**
or combination		0	1	1,0	kWh/d	1,00	365	d/a	0	*			1,00	/	8,76	=	**0**
Cooking		1	1	0,3	kWh/Use	1,00	500	/(P*a)	28125	*			0,50	/	8,76	=	**1605**
Lighting		1	1	60,0	W	1,00	2,9	kh/(P*a)	39150	*			1,00	/	8,76	=	**4469**
Consumer Electronics		1	1	80,0	W	1,00	0,55	kh/(P*a)	9900	*			1,00	/	8,76	=	**1130**
Household Appliances/Other		1	1	50,0	kWh	1,00	1,0	/(P*a)	11250	*			1,00	/	8,76	=	**1284**
Auxiliary Appliances (cf. Aux Electricity Sheet)																=	**214**
Other Applications (cf. Electricity Sheet)		0	0,0						0	*			0	/	8,76	=	**0**
Persons		225	1	80,0	W/P	1,00	8,76	kh/a	157680	*			0,55	/	8,76	=	**9900**
Cold Water		225	1	-4,0	W/P	1,00	8,76	kh/a								=	**-905**
DHW - circulation		1	1	182,8	W	1,00	8,76	kh/a	1601	*			1,00	/	8,76	=	**183**
DHW - individual pipes		1	1	7889,4	W	1,00	8,76	kh/a	69111	*			1,00	/	8,76	=	**7889**
DHW - storage		1	1	150,0	W	1,00	8,76	kh/a	1314	*			1,00	/	8,76	=	**150**
Evaporation		225	1	-25,0	W/P	1,00	8,76	kh/a	-49275	*			1,00	/	8,76	=	**-5625**
Total															W		**16278**
Specific Demand															W/m²		**12,49**
Heat Available From Internal Sources											189,2	d/a			kWh/(m²a)		**56,7**

EnerPHit planning: **INTERNAL HEAT GAINS non-residential Use**

Building: School "Tzanko Diustabanov"-Block A

Utilisation Pattern: School — 2,80 W/m²

Type of Values Used: Standard — No data input necessary

Calculation Internal Heat

Persons: 225,0 P — Treated floor area: 1303,46 m² — Heating period: 189,17 d/a — Room Temperature: 20 °C — Internal Heat Gains Aux. Electricity: 214,3 W

Column Nr.

Persons	Select	Utilisation Pattern	Select	Activity of Persons	Planning with the number of persons or via floor area of utilisation zone (planning via area only if the occupancy is available for this utilisation pattern). Pers./Area (1 / 0)	Number of Occupants		Floor Area of Utilisation Zone (m²)	Average Occupancy (Persons / m²) [27]	Heat emitted per person (W)	Utilisation Hours per Year [h/a] [9]	Relative Presence [18]	Used in Time Span (h/a)	Average Heat Emitted by Persons (W)
Persons A	1	Classroom	1	<= 10 yr., sitting	1 Planning with occupancy	205	or		0,333333333	60	1890	0,75	8760	1990
Persons B	1	Classroom	3	>10 yr., standing or light work	1 Planning with occupancy	20	or		0,333333333	100	1890	0,75	8760	324
Persons C				Invalid data input	Enter occupancy or floor area		or		No standard value	0	0	1,00	8760	0
Persons D				Invalid data input	Enter occupancy or floor area		or		No standard value	0	0	1,00	8760	0
Persons E				Invalid data input	Enter occupancy or floor area		or		No standard value	0	0	1,00	8760	0
Persons F				Invalid data input	Enter occupancy or floor area		or		No standard value	0	0	1,00	8760	0
Persons G				Invalid data input	Enter occupancy or floor area		or		No standard value	0	0	1,00	8760	0
Evaporation (person specific)						143					1890	0,75	8760	0

Lighting / Equipment / Aux. Electricity	Useful Energy [kWh/a]	Availability	Used in Time Period (kh/a)	Average Heat Release
Lighting	25585	1,00	8,76	2921
Office Applications (Within Therm. Envelope)	1092	1,00	8,76	125
Cooking (Within Therm. Envelope)	0	0,50	8,76	0
Dishwashing (Within Therm. Envelope)	0	0,30	8,76	0
Cooling (Within Therm. Envelope)	0	1,00	8,76	0
Other (Within Therm. Envelope)	0	1,00	8,76	0
Auxiliary Appliances (See Aux Electricity Worksheet)				214

Heat loss due to cold water (calculation from column AJ)	on/off (1 / 0)	Predominant Utilisation Pattern of Building (Data transfered from Electricity non-res worksheet; input kitchen) [2]	Number of WCs (user data)	Amount of WCs: Standard values for schools are used (X)	Number of WCs (calculation value)	DT: Cold Water Temp. - Room Temp. [K]	Occupied Days per Year [d/a] [8]	Loss daytime [W]	Loss Nighttime [W]	Availability	Used in Period (d/a)	Average Power Cold Water
Cold Water Due to Flushing WC		0			0	-8	0	0	-7	1,00	365	0

Total		W	5574
Specific Demand		W/m²	4,3
Heat Available From Internal Sources	189 d/a	kWh/(m²a)	19

EnerPHit planning:

PRIMARY ENERGY VALUE

Building: School "Tzanko Diustabanov"-Block A

Building type: School

Treated Floor Area A_{TFA}: 1303 m²

Space Heating Demand incl. Distribution: 251 kWh/(m²a)

Useful cooling demand incl. dehumidification: kWh/(m²a)

			Final Energy kWh/(m²a)	Primary Energy kWh/(m²a)	Emissions CO_2-Equivalent kg/(m²a)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Direct Electric Heating	$Q_{H,de}$		0,0	0,0	0,0
Hot water, direct electric (without DHW wash&dish)	$Q_{DHW,de}$	*(DHW+Distribution, SolarDHW)*	0,0	0,0	0,0
Electric Post heating DHW Wash&Dish		*(Electricity, SolarDHW)*	0,0	0,0	0,0
Electricity demand lighting/auxiliary tools/kitchen	Q_{EHH}	*(Electricity worksheet)*	20,5	53,2	13,9
Electricity Demand - Auxiliary Electricity			1,0	2,6	0,7
Total electricity demand (without heat pump)			21,5	55,8	14,6
Heat pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
Annual coefficient of performance of heat pump 1 (heating / heating&DHW)	SPF_{H-1}	*(HP worksheet)*			
Annual coefficient of performance of heat pump 2 (DHW)	SPF_{H-1}	*(HP worksheet)*			
Heat generation efficiency (excl. DHW wash&dish)		*(HP worksheet)*			
Heat generation efficiency (incl. DHW wash&dish)		*(HP worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(HP worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total electricity demand heat pump		*(HP worksheet)*	0,0	0,0	0,0
Compact Heat Pump Unit				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
COP Heat Pump Heating	SPF_{H-1}	*(Compact worksheet)*	0,0		
COP Heat Pump DHW	SPF_{H-1}	*(Compact worksheet)*	0,0		
Heat generation efficiency (excl. DHW wash&dish)		*(Compact worksheet)*			
Heat generation efficiency (incl. DHW wash&dish)		*(Compact worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(Compact worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total Compact Unit		*(Compact worksheet)*	0,0	0,0	0,0
Boiler				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%		250
Boiler Type		*(Boiler worksheet)*			
Performance Ratio of Heat Generator		*(Boiler worksheet)*	0%		
Annual Energy Demand (without DHW Wash&Dish)		*(Boiler worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total heating oil/gas/wood			0,0	0,0	0,0
District Heat				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	100%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	100%	0,8	240
Heat source		*(District heating worksheet)*	Hard Coal CGS 70% PHC		
Performance Ratio of Heat Generator		*(District heating worksheet)*	111%		
Heating Demand District Heat (without DHW Wash&Dish)		*(District heating worksheet)*	320,7	256,6	77,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total district heat			320,7	256,6	77,0
Other				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	0,2	55
Heat source		*(Project)*	Wood		
Performance Ratio of Heat Generator		*(Project)*	0%		
Annual Energy Demand, Space Heating			0,0	0,0	0,0
Annual Energy Demand, DHW (without DHW Wash&Dish)			0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Non-Electric Demand Cooking/Drying (Gas)		*(Electricity worksheet)*	0,0	0,0	0,0
Total - Other			0,0	0,0	0,0
Cooling with Electric Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
				kWh/kWh	g/kWh
Covered Fraction of Cooling Demand		*(Project)*	100%	2,6	680
Heat source			Electricity		
Seasonal energy efficiency ratio cooling					
Energy Demand Space Cooling			0,0	0,0	0,0
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			342,2	312,4	91,6

Total PE Value 312,4 kWh/(m²a)

Total emissions CO_2-Equivalent 91,6 kg/(m²a)

(Yes/No)

Primary Energy Requirement 402 kWh/(m²a) **yes**

Heating, DHW, auxiliary electricity (no lighting and electrical appliances)	321,7	259,2	77,6

Specific PE Demand - Mechanical System 259,2 kWh/(m²a)

Total emissions CO_2-Equivalent 77,6 kg/(m²a)

Solar electricity			kWh/a	PE-Value (Generation) kWh/kWh	CO_2-Emission Factor g/kWh
Planned Annual Electricity Generation		*(Worksheet PV)*			
Specific Demand					
PE Value: conservation by solar electricity				kWh/(m²a)	
Saved CO_2 emissions through solar electricity				kg/(m²a)	

EnerPHit planning: **HEAT PUMP**

Building:	School "Tzanko Diustabanov"-Block A		Building type:	School	
Climate:	Велико Търнов PHI		Treated Floor Area A_{TFA}:	1303	m²

Covered fraction of space heating demand			*(PE Value worksheet)*	0%	
Space Heat Demand + Distribution Losses		Q_H+Q_{HL}:	*(DHW+Distribution)*	326747	kWh/a
Solar fraction for space heat		$\eta_{Solar,\ H}$	*(SolarDHW worksheet)*	0%	
Effective Annual Heat Demand		$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		**0**	kWh/a
Covered Fraction of DHW Demand			*(PE Value worksheet)*	0%	
Total heat demand of DHW system		Q_{gDHW}	*(DHW+Distribution)*	49230	kWh/a
Solar fraction for DHW		$\eta_{Solar,\ DHW}$	*(SolarDHW worksheet)*	0%	
Effective DHW demand		$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		**0**	kWh/a
Number of heat pumps in the system				1	
Functionality				Heating & DHW	

Heating

Selection of HP:	None	Heat source:			
Selection of distribution system				Radiators	
Design distribution temperature		θ_{design}	*(DHW+Distribution)*	55,00	°C
Nomimal Power of distribution system		P_{nom}		150,00	kW

Distribution system (fulfilled from expert users only)

Nominal Power of distribution system		P_{nom}		150,00	kW
Radiator exponent		n		1,30	
Heating storage				No	
Specific heat losses storage		U * $A_{storage}$			W/K
Storage location in thermal envelope	Inside or outside of the thermal envelope			Outside	
Room temperature (Storage location: outside of thermal envelope)			*(DHW+Distribution)*	10,00	°C
Sink temperature of heat pump for heating		θ_{snk}		61,50	°C

Entries in relation to the domestic hot water system

Selection of HP:	Daikin Altherma 16 kW	Heat source:		Ambient air	
DHW temperature			*(DHW+Distribution)*	60,00	°C
DHW storage location	inside or outside of the thermal envelope			Outside	
Specific heat losses storage		U * $A_{storage}$		2,5	W/K
Room temperature (Storage location: outside of thermal envelope)			*(DHW+Distribution)*	10,00	°C
Type of backup heater				Electr. immersion heater	
Δθ of Electric flow type heater				5,0	K

In case of one heat pump with functionality: Heating & DHW

Same heat pump's sink temperature for Heating and for DHW				Yes	
Heat Pump Priority			*(Manufacturer, Techn. Data)*	DHW priority	

Control

Control strategy				On / off	

Heating

Depth (horizontal / vertical) ground heat exchanger		z		50,0	m
Power of pump for ground heat exchanger		P_{pump}		0,05	kW

EnerPHit planning: **H E A T P U M P**

0

Heating

Heat pump:
Source:

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1				
Test Point 2				
Test Point 3				
Test Point 4				
Test Point 5				
Test Point 6				
Test Point 7				
Test Point 8				
Test Point 9				
Test Point 10				
Test Point 11				
Test Point 12				
Test Point 13				
Test Point 14				
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ K

DHW

Heat pump:
Source:

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1				
Test Point 2				
Test Point 3				
Test Point 4				
Test Point 5				
Test Point 6				
Test Point 7				
Test Point 8				
Test Point 9				
Test Point 10				
Test Point 11				
Test Point 12				
Test Point 13				
Test Point 14				
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ K

Electrical energy consumption of pump (groundwater / groun	Q_{pump}	0	kWh/a
Energy by Direct Electricity	$Q_{E,dir}$	0	kWh/a
Space heat supplied by HP	$Q_{HP,Heating}$	0	kWh/a
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	0	kWh/a
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	0	kWh/a
Space heating supplied by HP without storage losses	$Q_{HP,Heating}$	0	kWh/a
Winter DHW supplied by HP without storage losses	$Q_{HP,DHW,Winter}$	0	kWh/a
Summer DHW supplied by HP without storage losses	$Q_{HP,DHW,Summer}$	0	kWh/a
Electrical consumption of HP	Qel_{HP}		kWh/a

		1. HP: Heating or heating & DHW	2. HP: Domestic hot water
Seasonal performance factor of Heat Pump	SPF_{H-1}		
Seasonal Performance factor of System	SPF_{H-3}		
Heat generation efficiency DHW & heating			
		kWh/a	kWh/(m²a)
Final electrical energy demand heat generation	Q_{final}		
Annual primary energy demand			
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions			

EnerPHit planning:

HP Ground (Ground probes / Ground collectors)

Building: School "Tzanko Diustabanov"-Block A
Climate: Велико Търнов PHI

Building type: School
Treated Floor Area A_{TFA}: 1303 m²

Ground probes

Probe field configuration		A	Individual probe	
Length of probe	*(HP worksheet)*	H	50	m
Probes spacing/distance		B		m
Depth (z=H/2)		z	25	m
Type of probe		A	Double-U	
Borehole radius		R_b		m
Inner radius of pipe		R_i		m
Exterior pipe radius		R_a		m
Distance between pipes		BU		m
Inner radius of pipe casing (only coaxial)		R_{i2}		m
Exterior radius casing pipe (only coaxial)		R_{a2}		m
Thermal conductivity of pipe		λ_R		W/(mK)
Thermal conductivity of back fill		λ_F		W/(mK)
Probe time constant		t_p	#DIV/0!	d
Internal borehole resistance		R_a		Km/W
Borehole resistance		R_b		Km/W

Ground

Soil type	J	0	
Density of the ground	ρ_E	0	kg/m³
Thermal capacity of ground	cp_E	0	J/(kgK)
Thermal conductivity of ground	λ_E	0,0	W/(mK)
Soil temperature conductivity	a_E	#DIV/0!	m/s²
Ground temperature gradient	ΔT_G	0,022	K/m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S		kg/s

Operation type

Waste heat of active cooling to ground probe? Please check, if applicable.			
Heat pump operation duration			h/a
Specific heat extraction rate as an annual average	q_{ex}		W/m
	H/R_b		W/K

Ground collectors

Inner radius of pipe	r_i	0,013	m
Exterior pipe radius	r_a	0,016	m
Thermal conductivity of pipe	λ_r	0,420	W/(mK)
Pipe depth	z_{pipe}	50	m
Ground water depth	z_{gw}		m
Pipe spacing	D	0,4	m
Base area		80	m²
Pipe outer surface		20,1	m²
Pipe length	L	200,0	m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S	0,5	kg/s
Specific heat extraction rate	q_{ex}		W/m²
U * A			W/K

Climate

Period duration		365	d
Average ground surface temperature	T_{m0}	11,7	°C
Surface temperature amplitude	T1	11,4	°C
Phase shifting surface	t_{02}	31	d

EnerPHit planning:

HP Ground (Ground probes / Ground collectors)

Ground characteristics		Thermal conductivity [W/(mK)]	Density [kg/m³]	Heat capacity [J/(kg K)]	Heat capacity [MJ/(m³ K)]	Temperature conductivity [10-7 m²/s]	Source
A	Sand, 9% moisture	0,980	1440	1507	2,170	4,520	[Neiß 1977]
B	Sand, 13% moisture	1,500	1600	1800	2,880	5,210	[Neiß 1977]
C	Ground, coarse gravel	0,520	2000	1840	3,680	1,410	[VDI 1984]
D	Loam, 36% moisture	2,300	1650	2847	4,700	4,900	[Neiß 1977]
E	Clay	1,280	1500	880	1,320	9,700	[VDI 1984]
F	Clay / Silt	2,200	2550	882	2,250	9,780	[VDI 2000]
G	Slate	2,100	2700	870	2,350	8,940	[VDI 2000]
H	Silt	1,500	1920	2938	5,640	2,660	[ISO 13370]
I	Rock	3,500	2500	2500	6,250	5,600	[ISO 13370]
J							

Properties of the brine		Temperature [°C]	Density [kg/m³]	Heat capacity [J/(kg K)]	Thermal conductivity [W/(mK)]	Dynamic viscosity [kg/(ms)]
A	Ethylene glycol 25%	2	1052	3950	0,480	0,0052
B	Potassium carbonate	2	1265	2941	0,544	0,0031
C	Potassium formate	2	1226	3190	0,534	0,00237
D	Water	2	997	4190	0,590	0,001307
E						

Result ground probe calculation

Month	Borehole Temperature °C
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

EnerPHit planning: **COMPACT UNIT WITH EXHAUST AIR HEAT PUMP**

Calculation based on measured values of the laboratory evaluation for component certification

Building: School "Tzanko Diustabanov"-Block A | Building type: School

Treated Floor Area A_{TFA}: 1303 m²

				incl. DHW Connection for Washing Machines & Dishwashers	
Covered fraction of space heating demand	*(PE Value worksheet)*	0%			
Space Heating Demand + Distribution Losses	Q_H+Q_{HL} *(DHW+Distribution)*	326747	kWh		
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%			
Effective Annual heating demand	$Q_{H,WI}=Q_H*(1-\eta_{Solar,\ H})$	0	kWh		
Covered Fraction of DHW Demand	*(PE Value worksheet)*	0%			
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	49863	kWh	49863	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%		0%	
Effective DHW Demand	$Q_{DHW,WI}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	0	kWh	0	kWh

Sort: AS LIST

Compact unit selection: Go to list of compact units

Measured Values from Laboratory Test Invalid selection: for the time being compact HP units or combined HPs can ONLY be considered as single units, meaning they can ONLY be calculated with the 'Ventilation' worksheet (please check the

Ventilation

Effective heat recovery efficiency	η_{eff} *(Test stand)*		
Electric Efficiency	*(Test stand)*		Wh/m³

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

Domestic Hot Water		*Test point 1*	*Test point 2*	*Test point 3*	*Test point 4*	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power DHW Storage Heating-Up	$P_{DHW,Heating-Up}$					kW
Measured Thermal Power DHW Storage Reload	$P_{DHW,Reload}$					kW
Measured COP DHW Storage Heating-Up	$COP_{DHW,Heating-Up}$					-
Measured COP DHW Storage Reload	$COP_{DHW,Reload}$					-
Standby (Inputs required only if different from storage reload)		*Test point 1*	*Test point 2*	*Test point 3*	*Test point 4*	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Standby	$P_{HP,Standby}$					kW
Measured COP Standby	$COP_{Standby}$					-

0%

Specific heat loss storage incl. connections	$U * A_{Storage}$ *(Test stand)*		W/K
Average Storage Temperature in Standby Mode	$T_{DHW,Standby}$ *(Test stand)*		°C

Heat pump priority: separate heat pumps | DHW Priority | Heating priority

Room temperature (°C)		20
Av. Ambient Temp. Heating P. (°C)		4
Av. Ground Temp (°C)		12
Efficiency SHX Exhaust Air Mixing	η^*_{SHX}	
Heat Recovery Efficiency SHX Exhaust Air Mixing (if applicable)	$\eta_{SHX,add}$ *(Design Value)*	0%
Volume Flow Rate of Added Exhaust Air (if applicable)	V_{add} *(Test stand)*	m³/h
Hydraulic frost protection		

				incl. DHW Connection for Washing Machines & Dishwashers	
Heat supplied by direct electricity	$Q_{E,dir}$		kWh/a		kWh/a
Space heat supplied by HP	$Q_{HP,Heating}$		kWh/a		kWh/a
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	0	kWh/a	0	kWh/a
Winter standby heat supplied by HP	$Q_{HP,Standby,Winter}$		kWh/a		kWh/a
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	0	kWh/a	0	kWh/a
Summer standby heat supplied by HP	$Q_{HP,Standby,Summer}$		kWh/a		kWh/a

Performance Ratio of Heat Generator, DHW & Space Heating					
Annual Coefficient of Performance	SPF_{H-3}				
		kWh/a	kWh/(m²a)	kWh/a	kWh/(m²a)
Final energy demand heat generation	Q_{final}				
Annual primary energy demand					
		kg/a	kg/(m²a)	kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions					

EFFICIENCY OF HEAT GENERATION (gas, oil & wood)

Building: School "Tzanko Diustabanov"-Block A

Building type: School

Treated Floor Area A_{TFA}: 1303 m²

Covered fraction of space heating demand	*(PE Value worksheet)*	0%	
Space Heating Demand + Distribution Losses	Q_H+Q_{HS} *(DHW+Distribution)*	326747	kWh
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$	**0**	kWh
Space Heating Demand without Distribution Losses	Q_H *(Verification sheet)*	325942	kWh
Covered Fraction of DHW Demand	*(PE Value worksheet)*	0%	
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	49863	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	**0**	kWh

Additional selection only in the case of Natural Gas

Boiler Type	*(Project)*	None	
Primary Energy factor	*(Data worksheet)*		kWh/kWh
CO_2-Emissions Factor (CO_2-Equivalent)		250	g/kWh
Useful heat provided	Q_{Use}		kWh/a
Max. Heating Power Required for Heating the Building	P_{BH} *(Heating load worksheet)*	136,98	kW
Length of the Heating Period	t_{HP}	4540	h
Length of DHW Heating Period	t_{DHW}	8760	h

Use characteristic values entered (check if appropriate)?

		Project Data		Standard Values		Input field	
Design Output	P_{Nom} *(Rating Plate)*	137	kW	137	kW		
Installation of Boiler (Outdoor: 0, Indoor: 1)		0		0			
Input Values (Oil and Gas Boiler)		Project Data		Standard Values		Input field	
Boiler Efficiency at 30% Load	$\eta_{30\%}$ *(Manufacturer)*						
Boiler Efficiency at Nominal Output	$\eta_{100\%}$ *(Manufacturer)*						
Standby Heat Loss Boiler at 70 °C	$q_{B,70}$ *(Manufacturer)*						
Average Return Temperature Measured at 30% Load	$\vartheta_{30\%}$ *(Manufacturer)*		°C				
Input Values (Biomass Heat Generator)		Project Data		Standard Values		Input field	
Efficiency of Heat Generator in Basic Cycle	η_{GZ} *(Manufacturer)*			60%			
Efficiency of Heat Generator in Constant Operation	η_{SO} *(Manufacturer)*			70%			
Average Fraction of Heat Output Released to Heating Circuit	$z_{HC,m}$ *(Manufacturer)*			0,4			
Temperature Difference Betw. Power-On and Power-Off	$\Delta\vartheta$ *(Manufacturer)*		K	30	K		
For Interior Installations: Area of Mechanical Room	$A_{install}$ *(Project)*		m²	0	m²		
Useful heat output per basic cycle	$Q_{N,GZ}$ *(Manufacturer)*		kWh	205,5	kWh		
Average Power Output of the Heat Generator	$Q_{N,m}$ *(Manufacturer)*		kW	137,0	kW		
Heat generator without pellets conveyor							
Unit with regulation (no fan / no starting aid)							
Heating energy demand for a basic machine cycle	$Q_{HE,GZ}$ *(Manufacturer)*		kWh		kWh		kWh
Power consumption in steady state operation	$P_{el,SB}$ *(Manufacturer)*		W		W		W

Utilisation factor heat generator heating run	$h_{H,g,K}=f_{\vartheta}*\eta_{K}$	0%
Utilisation factor heat generator DHW run	$h_{TW,g,K}=\eta_{100\%}/f_{\vartheta,TW}$	0%
Utilisation factor heat generator DHW & heating	$h_{g,K}$	0%

		kWh/a	kWh/(m²a)
Final energy demand space heating	$Q_{Final,\ HE}$ = $Q_{H,wi}$* $e_{H,g,K}$	0	
Final energy demand DHW	$Q_{Final,\ DHW}$ = $Q_{DHW,wi}$* $e_{TW,g,K}$	0	
Total final energy demand	Q_{Final} = $Q_{Final,DHW}$ + $Q_{Final,HE}$	0	0,0
Annual primary energy demand			
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		0	0,0

Building:	School "Tzanko Diustabanov"-Block A		Building type:	School
			Treated Floor Area A_{TFA}:	1303 m²
Covered fraction of space heating demand		*(PE Value worksheet)*	100%	
Annual heating demand kWh/a		Q_H *(DHW+Distribution)*	326747	kWh
Solar contribution for space heaing		$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		326747	kWh
Covered Fraction of DHW Demand		*(PE Value worksheet)*	100%	
DHW Demand		Q_{DHW} *(DHW+Distribution)*	49863	kWh
Solar contribution for DHW		$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		49863	kWh
Heat source			Hard Coal CGS 70% PHC	
Primary Energy factor		*(Data worksheet)*	0,8	kWh/kWh
CO_2-Emissions factor (CO_2-Equivalent)		*(Data worksheet)*	240	g/kWh
Utilisation factor of heat transfer station	ha,HX		111%	

		kWh/a	kWh/(m²a)
Final energy demand heat generation	$Q_{final} = Q_{Use} * e_{a,DH}$	418037	320,7
Annual primary energy demand		334430	256,6
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		100329	77,0

Table of Primary Energy Factors and CO_2-Equivalent Emissions Factors of Various Energy Carriers

Energy Type		Energy Carrier	PE (non-regenerative) kWh_{Prim}/kWh_{Final}	CO_2 GEMIS 3.0 kg/kWh_{Final}
	1	None		
Fuel Source	2	Oil	1,1	0,31
	3	Natural Gas	1,1	0,25
	4	LPG	1,1	0,27
	5	Hard Coal	1,1	0,44
	6	Wood	0,2	0,05
Electricity	7	Electricity-Mix	2,6	0,68
	8	Electricity from Photovoltaics	0,7	0,25
	1	None	0	0
District Heat	2	Hard Coal CGS 70% PHC	0,8	0,24
	3	Hard Coal CGS 35% PHC	1,1	0,32
	4	Hard Coal HS 0% PHC	1,5	0,41
Gas CGS	5	Gas CGS 70% PHC	0,7	-0,07
	6	Gas CGS 35% PHC	1,1	0,13
	7	Gas HS 0% PHC	1,5	0,32
Heating Oil-EL CGS	8	Oil CGS 70% PHC	0,8	0,1
	9	Oil CGS 35% PHC	1,1	0,25
	10	Oil HS 0% PHC	1,5	0,41

Data Source: DIN V 4701-10/GEMIS 4.14

Heat Generator		Selection of gas type	
Nr.	Type	Nr.	Type
1	None	1	Natural Gas
2	Improved gas condensing boi-ler	2	LPG
3	Improved oil condensing boi-ler	3	
4	Condensing boiler gas		
5	Condensing boiler oil		
6	Low Temperature Boi-ler Gas		
7	Low Temperature Boi-ler Oil		
8	Wood Log Burning (Direct and Indirect Release of Heat)		
9	Wood Pellet Burning (Direct and Indirect Release of Heat)		
10	Wood Pellet Burning (Only Indirect Release of Heat)		
11	Reserve		

Dishwashing	Washing
1	DHW Connection
2	Cold water connection

Clothes Drying		Availability Electricity	Availability Evaporation
1	Clothesline	1	1
2	Drying Closet (cold!)	1	1
3	Drying Closet (cold!) in Exhaust Air	0,9	0,9
4	Condensation Dryer	0,7	0
5	Electric Exhaust Air Dryer	1	1
6	Gas Exhaust Air Dryer	1	1

Cooking		Electric Fraction	Primärenergiefaktor	CO_2 factor
1	Electricity	100%	2,6	0,68
2	Natural Gas	0%	1,1	0,25
3	LPG	0%	1,1	0,27