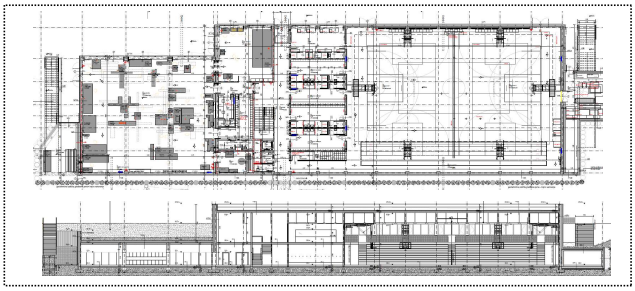
PHPP-Energy balance calculation



Building:	Šolski center Slovenj Gradec - telovadnica		
Street:	k.o. Slovenj Gradec, Gosposvetska cesta		
Postcode/City:	3230	Šentjur	
Province/Country:	Slovenija		SI-Slovenia
Building type:	Športna dvorana		
Climate data set:	ud---01-Ljubljana T1996-2005/J1981-2000		
Climate zone:	3: Cool-temperate	Altitude of location:	309 m
Home owner / Client:	Ministrstvo za izobraževanje, znanos in šport		
Street:	Masarykova cest 16		
Postcode/City:	1000	Ljubljana	
Province/Country:	Slovenija		SI-Slovenia

Architecture:	Plan B d.o.o.		
Street:	Gregorčičeva 21/b		
Postcode/City:	2000	Maribor	
Province/Country:	Slovenija		SI-Slovenia
Energy consultancy:	REING d.o.o.		
Street:	Borovnjakova 12		
Postcode/City:	9000	Murska Sobota	
Province/Country:	Slovenija		SI-Slovenia

Mechanical engineer:	Klimada maks d.o.o.		
Street:	Partizanska cesta 3		
Postcode/City:	2000	Maribor	
Province/Country:	Slovenija		SI-Slovenia
Certification:			
Street:			
Postcode/City:			
Province/Country:			2-User determined

Year of construction:	2018	Interior temperature winter [°C]:	20,0	Interior temp. summer [°C]:	25,0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2,1	IHG cooling case [W/m²]:	2,1
No. of occupants:	150,0	Specific capacity [Wh/K per m² TFA]:	204	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	2043,1				
Space heating	Heating demand	kWh/(m²a)	24,5	≤	-	-	-
	Heating demand	**kWh/(m³a)**	3,87				
	Heating load	W/m²	15,3	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	3,7	≤	-	-	-
	Cooling load	W/m²	5,7	≤	-	-	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	0,0	≤	-		-
Airtightness	Pressurization test result n_{50}	1/h	0,6	≤	-		-
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	40	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	57	≤	-	-	-
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	0,0	≥	-	-	

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

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

Task:	First name:	Surname:	Signature:
	Matej	Kramar	-
	Issued on:	City:	
	12.04.18	Murska Sobota	

POPRAVLJENE LASTNOSTI PROFILOV IN STEKEL GLEDE NA DOKAZILA; POPRAVLJENE LASTNOSTI KLIMATA

U-value of building assemblies

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PE

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

Assembly no.	Building assembly description	Interior insulation?
01ud	P2 Športna dvorana, igrišče	

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17
Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
plavajoči leseni pod	0,200					39
sloj zraka	0,340	(s talnim ogrevanjem)				55
PE folija	0,190					0
kamena volna 035	0,035	(npr. KI DP-5)		lesena konstrukcija	0,130	100
hidroizolacija	0,190					5
AB talna plošča	2,200					150
XPS 035	0,035	(npr. Fibran xps 300L)				120
gramozni tampon	1,600					300

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
90%		10,0%	76,9 cm

U-value supplement: W/(m²K)

U-value: 0,150 W/(m²K)

Assembly no.	Building assembly description	Interior insulation?
02ud	P2a Športna dvorana, ostale površine	

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17
Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
epoksi tlak	0,700					3
mikroarmirani beton	2,200	(s talnim ogrevanjem)				72
PE folija	0,190					0
EPS 036	0,036	(npr. FRAGMAT EPS 100)				120
hidroizolacija	0,190					5
AB talna plošča	2,200					150
XPS 035	0,035	(npr. Fibran xps 300L)				120
gramozni tampon	1,600					300

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			77,0 cm

U-value supplement: W/(m²K)

U-value: 0,138 W/(m²K)

Assembly no.	Building assembly description	Interior insulation?
03ud	P3 Garderobe, sanitarije, komunikacije, lakirnica	

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17
Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
mikroarmirani beton	2,200	(s talnim ogrevanjem)				95
PE folija	0,190					0
EPS 036	0,036	(npr. Fragm. EPS 100)				100
hidroizolacija	0,190					5
AB talna plošča	2,200					150
XPS 035	0,035	(npr. Fibran xps 300L)				120
gramozni tampon	1,600					300

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			77,0 cm

U-value supplement: W/(m²K)

U-value: 0,149 W/(m²K)

Assembly no. | Interior insulation?

04ud | **P4 Strojne delavnice, skladišče, ročna delavnica, kabinet (IZVEN FAZE 1)**

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
mikroarmirani beton	2,200	(s talnim ogrevanjem)				95
PE folija	0,190					0
EPS 036	0,036					100
hidroizolacija	0,190					5
AB talna plošča	2,200					150
XPS 035	0,035					120
gramozni tampon	1,600					300

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 77,0 cm

U-value supplement: W/(m²K) | **U-value: 0,149** W/(m²K)

Assembly no. | Interior insulation?

05ud | **N5 Tla povezovalnega hodnika**

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
mikroarmirani beton	2,200	(s talnim ogrevanjem)				68
PE folija	0,190					0
EPS 036	0,036	(npr. Fragm. EPS100)				30
AB talna plošča	2,200					200
XPS 035	0,035	(npr. Fibran xps 300L)				200
hidroizolacija	0,190					5
podložni beton	2,200					100
gramozni tampon	1,600					300

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 90,3 cm

U-value supplement: W/(m²K) | **U-value: 0,141** W/(m²K)

Assembly no. | Interior insulation?

06ud | **S1 Ravna streha nad telovadnico**

Heat transmission resistance [m²K/W]

Orientation of building element: 1-Roof — interior R_{si}: 0,10

Adjacent to: 1-Outdoor air — exterior R_{se}: 0,04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
mavčno-kartonske plošče	0,210					13
zračni prostor	0,370					60
folija	0,190					0
OSB plošča	0,130					18
kamena volna 035	0,035	(npr. KI DP-8)		morali 10/22	0,130	220
OSB plošča	0,130					22
kamena volna 039	0,039	(npr. KI DDP)				120
strešna HI folija	0,190					10

Percentage of sec. 1: 84% | Percentage of sec. 2 | Percentage of sec. 3: 16,0% | Total: 46,3 cm

U-value supplement: W/(m²K) | **U-value: 0,117** W/(m²K)

Assembly no.		Interior insulation?
07ud	S2 Streha strojne delavnice (NI DEL FAZE 1)	

Heat transmission resistance [m²K/W]

Orientation of building element: 1-Roof — interior R_{si}: 0,10

Adjacent to: 1-Outdoor air — exterior R_{se}: 0,04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB plošča	2,200					220
naklonski beton	1,600	(od 2 do 17cm)				95
bitumen	0,190					5
EPS 031	0,031					240
hidroizolacija	0,190					10
folija	0,190					1
prodec	1,600					100
zemlja	2,000					400

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			107,1 cm

U-value supplement: W/(m²K)

U-value: 0,119 W/(m²K)

Assembly no.		Interior insulation?
08ud	S2* Streha strojne delavnice v naklonu (NI DEL FAZE 1)	

Heat transmission resistance [m²K/W]

Orientation of building element: 3-Floor — interior R_{si}: 0,17

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB plošča	2,200					220
naklonski beton	1,600	(od 2 do 17cm)				95
bitumen	0,190					5
EPS 031	0,031			(24cm + naklon 0-70cm)		590
hidroizolacija	0,190					10
folija	0,190					1
prodec	1,600					100
zemlja	2,000					400

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			142,1 cm

U-value supplement: W/(m²K)

U-value: 0,051 W/(m²K)

Assembly no.		Interior insulation?
09ud	S3 Streha shrambe orodja	

Heat transmission resistance [m²K/W]

Orientation of building element: 1-Roof — interior R_{si}: 0,10

Adjacent to: 1-Outdoor air — exterior R_{se}: 0,04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
XPS 035	0,035	(npr. Fibran XPS300L)				20
AB plošča	2,200					220
naklonski beton	1,600	(od 2 do 5cm)				35
hidroizolacija	0,190					9
XPS 035	0,035	(npr. Fibran XPS300L)				200
folija	0,190					1
prodec	1,600					50
zemlja	2,000					260

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			79,5 cm

U-value supplement: W/(m²K)

U-value: 0,148 W/(m²K)

Assembly no. | Interior insulation?

10ud | **S5 Streha povezovalnega hodnika**

Heat transmission resistance [m²K/W]

Orientation of building element: **1-Roof** | interior R_{si}: 0,10

Adjacent to: **1-Outdoor air** | exterior R_{se}: 0,04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB plošča	**2,200**					**200**
naklonski beton	**1,600**	**(od 2 do 17cm)**				**95**
parna zapora	**0,190**					**5**
EPS 031	**0,031**	**(npr. F. NeoSuper100)**				**240**
hidroizolacija	**0,190**					**10**
folija	**0,190**					**1**
prodec	**1,600**					**100**
zemlja	**2,000**					**400**

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: **105,1** cm

U-value supplement: W/(m²K)

U-value: 0,119 W/(m²K)

Assembly no. | Interior insulation?

11ud | **Z1 Kletna stena v terenu**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0,13

Adjacent to: **2-Ground** | exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB kletna stena	**2,200**					**250**
hidroizolacija	**0,190**					**5**
XPS 035	**0,035**	**(npr. Fibran XPS 300L)**				**220**
zasutje	**1,600**					**500**

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: **97,5** cm

U-value supplement: W/(m²K)

U-value: 0,146 W/(m²K)

Assembly no. | Interior insulation?

12ud | **Z2 Stena v koridorju**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0,13

Adjacent to: **1-Outdoor air** | exterior R_{se}: 0,04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB stena	**2,200**					**250**
kamena volna 036	**0,036**	**(StoThermMineral)**				**250**
omet	**0,800**					**10**
prezračevan koridor						

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: **51,0** cm

U-value supplement: W/(m²K)

U-value: 0,138 W/(m²K)

Assembly no. 13ud | **Z3 Kletna stena** | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0,13

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB kletna stena	2,200					250
hidroizolacija	0,190					3
XPS 035	0,035	(npr. Fibran XPS 300L)		povečana debelina!		220
beton	1,600					100
pilotna stena						

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
85%	15,0%		57,3 cm

U-value supplement: W/(m²K)

U-value: 0,151 W/(m²K)

Assembly no. 14ud | **Z4 Kletna stena jaška** | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0,13

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB kletna stena	2,200					250
hidroizolacija	0,190					3
XPS 035	0,035	(npr. Fibran XPS 300L)				220
beton	1,600					100
pilotna stena						

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

U-value supplement: W/(m²K)

U-value: 0,151 W/(m²K)

Assembly no. 15ud | **Z5 Zidovi povezovalnega hodnika** | Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0,13

Adjacent to: 2-Ground — exterior R_{se}: 0,00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB kletna stena	2,200					250
hidroizolacija	0,190					3
XPS 035	0,035	(npr. Fibran XPS 300L)				220
beton	1,600					100

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

U-value supplement: W/(m²K)

U-value: 0,151 W/(m²K)

Assembly no. | Interior insulation?

16ud | **F1 Lahka fasadna stena telovadnice**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0,13

Adjacent to: **3-Ventilated** | exterior R_{se}: 0,13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
lesene plošče	0,130	(npr. KLH, CLT)				120
PUR/PIR	0,021	(npr. WeberTherm+UI)				50
kamena volna 035	0,035	(npr. KI FP 035)				110
folija	0,190					1
podkonstrukcija						
fasadna ploč. obloga						

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

U-value supplement: W/(m²K)

U-value: 0,149 W/(m²K)

Assembly no. | Interior insulation?

17ud | **F1a Masivna fasadna stena pritličja**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0,13

Adjacent to: **3-Ventilated** | exterior R_{se}: 0,13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB stena	2,200					500
PUR/PIR	0,021	(npr. WeberTherm+UI)				60
kamena volna 035	0,035	(npr. KI FPL-035)				120
folija	0,190					1
podkonstrukcija						
fasadna ploč. obloga						

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: **68,1** cm

U-value supplement: W/(m²K)

U-value: 0,148 W/(m²K)

Assembly no. | Interior insulation?

18ud | **F2a Masivna fasadna stena nadstropja**

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** | interior R_{si}: 0,13

Adjacent to: **3-Ventilated** | exterior R_{se}: 0,13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
AB stena	2,200					400
PUR/PIR	0,021	(npr. WeberTherm+UI)				60
kamena volna 035	0,035	(npr. KI FPL-035)				120
folija	0,190					1
podkonstrukcija						
fasadna lesena obloga						

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: **58,1** cm

U-value supplement: W/(m²K)

U-value: 0,149 W/(m²K)

Assembly no.		Interior insulation?
19ud	**F2b Fasadna stena telovadnice**	

Heat transmission resistance [m²K/W]

Orientation of building element: **2-Wall** — interior R_{si}: 0,13

Adjacent to: **3-Ventilated** — exterior R_{se}: 0,13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
lesene plošče	**0,130**	**(npr. KLH, CLT)**				**120**
PUR/PIR	**0,021**	**(npr. WeberTherm+UI)**				**60**
kamena volna 035	**0,035**	**(npr. KI FPL-035)**				**100**
folija	**0,190**					**1**
podkonstrukcija						
fasadna lesena obloga						

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			**28,1** cm

U-value supplement: W/(m²K)

U-value: 0,145 W/(m²K)

Assembly no.		Interior insulation?
20ud		

Heat transmission resistance [m²K/W]

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

Adjacent to: — exterior R_{se}:

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

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

U-value supplement: W/(m²K)

U-value: W/(m²K)

Heat losses through the ground

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Building section 1

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

Climate data			
Avg indoor temp. winter	T_i	20,0	°C
Avg indoor temp. summer	T_i	25,0	°C
Avg ground surface temperature	$T_{g,ave}$	11,8	°C
Amplitude of $T_{g,ave}$	$T_{g,\wedge}$	10,4	°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	71,4	kKh/a

Building data							
Area of ground floor slab / basement c	A	1509,9	m²	U-value floor slab/basement ceiling	U_f	0,150	W/(m²K)
Perimeter length	P	166,5	m	TBs floor slab / basement ceiling	Ψ_B*l	0,00	W/K
Charact. dimension of floor slab	B'	18,14	m	U-value floor slab / basement ceiling i	U_f'	0,150	W/(m²K)
				Equivalent thickness floor	d_t	13,30	m

Floor slab type (select only one)

x	**Slab on grade**							
	Perimeter insulation width/depth	D	1,35	m	Orientation of perimeter insulation	horizontal		
	Perimeter insulation thickness	d_n	0,22	m	(check only one field)	vertical	x	
	Conductivity perimeter insulation	λ_n	0,035	W/(mK)				
	Heated basement or floor slab completely / partially below ground level							
	Basement wall height below ground le	z		m	U-Value wall below ground	U_{wB}		W/(m²K)
	Unheated basement							
	Height aboveground wall	h		m	U-Value wall above ground	U_W		W/(m²K)
	Basement wall height below ground le	z		m	U-Value wall below ground	U_{WB}		W/(m²K)
	Air change unheated basement	n		h^{-1}	U-Value basement floor slab	U_{fB}		W/(m²K)
	Air volume basement	V		m³				
	Suspended floor above a ventilated crawl space (at max. 0.5 m below ground)							
	U-Value crawl space	U_{Crawl}		W/(m²K)	Area of ventilation openings	εP		m²
	Height of crawl space wall	h		m	Wind velocity at 10 m height	v		m/s
	U-Value crawl space wall	U_W		W/(m²K)	Wind shield factor	f_W		-

Additional thermal bridge heat losses at perimeter							
				Steady-state fraction	$\Psi_{P,stat}$*l		W/K
Phase shift	β		Months	Harmonic fraction	$\Psi_{P,harm}$*l		W/K

Groundwater correction							
Depth of the groundwater table	z_w	3,0	m	Groundwater correction factor	G_w	1,14058875	-
Groundwater flow rate	q_w	0,05	m/d				

Interim results

Phase shift	β	1,41	Months	Steady-state heat flow	Φ_{stat}	1253,0	W
Steady-state transmittance	L_S	153,27	W/K	Periodic heat flow	Φ_{harm}	92,2	W
Exterior periodic transmittance	L_{pe}	19,46	W/K	Heat losses during heating period	Q_{tot}	6057	kWh
Transmittance building	L_0	227,10	W/K				

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

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

Design ground temperature for 'Heating load' worksheet 13,6 **For 'Cooling load' worksheet** 17,0

Reduction factor for 'Annual heating' worksheet 0,37

Total result (all building parts)

Phase shift	β	1,41	Months	Steady-state heat flow	Φ_{stat}	1253,0	W
Steady-state transmittance	L_S	153,27	W/K	Periodic heat flow	Φ_{harm}	92,2	W
Exterior periodic transmittance	L_{pe}	19,46	W/K	Heat losses during heating period	Q_{tot}	6057	kWh
Transmittance building	L_0	227,10	W/K	Charact. dimension of floor slab	B'	18,14	m

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

Month	1	2	3	4	5	6	7	8	9	10	11	12	Avg. value
Winter	**13,8**	**13,6**	**13,6**	**13,9**	**14,3**	**14,8**	**15,1**	**15,4**	**15,3**	**15,1**	**14,7**	**14,2**	**14,5**
Summer	**15,4**	**15,2**	**15,3**	**15,5**	**15,9**	**16,4**	**16,8**	**17,0**	**17,0**	**16,7**	**16,3**	**15,8**	**16,1**

Design ground temperature for 'Heating load' worksheet **13,6** **For 'Cooling load' worksheet** **17,0**

Reduction factor for 'Annual heating' worksheet **0,37**

Areas determination

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment	Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]	Radiation-load cooling period [kWh/a]
								8 Months	5 Months
	Treated floor area	1	**2043,07**	m²	*Treated floor area according to PHPP manual*				
A	**North windows**	2	**5,04**	m²		**North windows**	**0,903**	**248**	**407**
A	**East windows**	3	**182,00**	m²	Results come from the 'Windows' worksheet.	**East windows**	**0,871**	**11093**	**20741**
A	**South windows**	4	**0,00**	m²	Window areas are subtracted from individual opaque areas.	**South windows**			
A	**West windows**	5	**75,60**	m²	which is displayed in the 'Windows' worksheet.	**West windows**	**0,842**	**2372**	**12002**
A	**Horizontal windows**	6	**0,00**	m²		**Horizontal windows**			
A	**Exterior door**	7	**37,04**	m²	*Please subtract area of door from respective building assembly*	**Exterior door**	**0,900**		
A	**External wall - Ambient**	8	**1269,41**	m²	*Temperature zone "A" is ambient air*	**External wall - Ambient**	**0,145**	**279**	**670**
B	**External wall - Ground**	9	**122,56**	m²	*Temperature zone "B" is the ground*	**External wall - Ground**	**0,151**		
A	**Roof/Ceiling - Ambient**	10	**1590,73**	m²		**Roof/Ceiling - Ambient**	**0,118**	**175**	**1889**
B	**Floor slab / Basement ceiling**	11	**1585,53**	m²		**Floor slab / Basement ceiling**	**0,148**		
		12	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
		13	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
X		14	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*				
						Thermal bridges - Overview	**Ψ [W/(mK)]**		
A	**Thermal bridges Ambient**	15	**167,00**	m	*Units in m*	**Thermal bridges Ambient**	**0,050**		
P	**Perimeter thermal bridges**	16	**211,90**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*	**Perimeter thermal bridges**	**0,150**		
B	**Thermal bridges FS/BC**	17	**239,60**	m	*Units in m*	**Thermal bridges FS/BC**	**0,150**		
I	**Building element towards neigh**	18	**0,00**	m²	*No heat losses, only considered for the heating load calculation*	**Building element towards neighbour**			
Total thermal envelope			**4867,92**	**m²**		**Average therm. envelope**	**0,197**		

Go to building components list

Area input

1-Sorting: AS LIST

Area no.	Building assembly description	To group No.	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User determined [m²]	-	User subtraction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection building assembly / Building system	U-Value [W/(m²K)]	Deviation from North	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
	Projected building footprint	**0**	Projected building footprint	**1**	x (		x		+	**1588,13**	-		)		=	1588,1								
	Treated floor area	**1**	Treated floor area	**1**	x (		x		+	**2043,07**	-		)		=	2043,1								
	Exterior door	**7**	Exterior door		x (		x		+		-		) -		=		Exterior door							
1	**Neto prostornina**				x (		x		+	**12935,40**	-		) -	**0,0**	=									
2	**Svetla višina povprečno**				x (		x		+	**6,33**	-		) -	**0,0**	=									
3					x (	**56,60**	x	**26,50**	+		-		) -	**0,0**	=									
4					x (	**22,25**	x	**21,15**	+		-	**4,17**	) -	**0,0**	=									
5					x (	**6,75**	x	**8,85**	+		-		) -	**0,0**	=									
6	**tla na terenu skupaj**				x (		x		+	**2026,06**	-		) -	**0,0**	=									
7	**obseg**				x (		x		+	**224,20**	-		) -	**0,0**	=									
8					x (		x		+		-		) -	**0,0**	=									
9					x (		x		+		-		) -	**0,0**	=									
10	**streha povezovalnega dela**	**10**	Roof/Ceiling - Ambient	**1**	x (	**5,35**	x	**3,25**	+		-		) -	**0,0**	=	17,4	**10ud-S5 Streha povezovalnega hodnika**	**0,119**	**240**	**0**	**Hor**	**0,40**	**0,60**	**0,90**
11	**tla povezovalnega dela**	**11**	Floor slab / Basement ceiling	**1**	x (	**4,55**	x	**3,25**	+		-		) -	**0,0**	=	14,8	**05ud-N5 Tla povezovalnega hodnika**	**0,141**						
12	**tla povezovalnega dela**	**10**	Roof/Ceiling - Ambient	**1**	x (	**0,80**	x	**3,25**	+		-		) -	**0,0**	=	2,6	**05ud-N5 Tla povezovalnega hodnika**	**0,141**	**240**	**0**	**Hor**	**0,10**	**0,60**	**0,90**
13	**stena povezovalnega dela**	**9**	External wall - Ground	**1**	x (	**5,35**	x	**3,25**	+		-		) -	**0,0**	=	17,4	**15ud-Z5 Zidovi povezovalnega hiodnika**	**0,151**						
14					x (		x		+		-		) -	**0,0**	=									
15	**stena delavnic proti koridorju**	**8**	External wall - Ambient	**0**	x (	**22,35**	x	**6,55**	+		-		) -	**0,0**	=	0,0	**12ud-Z2 Stena v koridorju**	**0,138**	**240**	**90**	**West**	**0,10**	**0,60**	**0,90**
16	**stena delavnic proti skladišču**	**8**	External wall - Ambient	**0**	x (	**9,30**	x	**5,70**	+		-		) -	**0,0**	=	0,0	**12ud-Z2 Stena v koridorju**	**0,138**	**330**	**90**	**North**	**0,10**	**0,60**	**0,90**
17	**stena delavnic proti prehodu**	**8**	External wall - Ambient	**0**	x (	**11,95**	x	**4,85**	+		-	**0,00**	) -	**0,0**	=	0,0	**17ud-F1a Masivna fasadna stena pritličja**	**0,148**	**330**	**90**	**North**	**0,10**	**0,60**	**0,90**
18	**stena delavnic SV**	**8**	External wall - Ambient	**0**	x (	**21,90**	x	**4,85**	+		-		) -	**0,0**	=	0,0	**17ud-F1a Masivna fasadna stena pritličja**	**0,148**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
19	**tla na terenu delavnice**	**11**	Floor slab / Basement ceiling	**0**	x (	**22,25**	x	**21,15**	+		-	**4,17**	) -	**0,0**	=	0,0	**04ud-P4 Strojne delavnice, skladišče, ročna delavnica, kabinet**	**0,149**						
20	**streha delavnic ravni del**	**10**	Roof/Ceiling - Ambient	**0**	x (	**10,80**	x	**21,90**	+		-		) -	**0,0**	=	0,0	**07ud-S2 Streha strojne delavnice**	**0,119**	**60**	**0**	**Hor**	**0,70**	**0,60**	**0,90**
21	**streha delavnic poševnina**	**10**	Roof/Ceiling - Ambient	**0**	x (		x		+	**0,00**	-	**0,00**	) -	**0,0**	=	0,0	**08ud-S2* Streha strojne delavnice v naklonu**	**0,051**	**60**	**20**	**Hor**	**0,80**	**0,60**	**0,90**
22					x (		x		+		-		) -	**0,0**	=									

Areas determination

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment	Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a]	Radiation-load cooling period [kWh/a]
								8 Months	5 Months
	Treated floor area	1	**2043,07**	m²	*Treated floor area according to PHPP manual*				
A	**North windows**	2	**5,04**	m²	Results come from the 'Windows' worksheet.	**North windows**	**0,903**	**248**	**407**
A	**East windows**	3	**182,00**	m²	Window areas are subtracted from individual opaque areas.	**East windows**	**0,871**	**11093**	**20741**
A	**South windows**	4	**0,00**	m²	which is displayed in the 'Windows' worksheet.	**South windows**			
A	**West windows**	5	**75,60**	m²		**West windows**	**0,842**	**2372**	**12002**
A	**Horizontal windows**	6	**0,00**	m²		**Horizontal windows**			
A	**Exterior door**	7	**37,04**	m²	*Please subtract area of door from respective building assembly*	**Exterior door**	**0,900**		
A	**External wall - Ambient**	8	**1269,41**	m²	*Temperature zone "A" is ambient air*	**External wall - Ambient**	**0,145**	**279**	**670**
B	**External wall - Ground**	9	**122,56**	m²	*Temperature zone "B" is the ground*	**External wall - Ground**	**0,151**		
A	**Roof/Ceiling - Ambient**	10	**1590,73**	m²		**Roof/Ceiling - Ambient**	**0,118**	**175**	**1889**
B	**Floor slab / Basement ceiling**	11	**1585,53**	m²		**Floor slab / Basement ceiling**	**0,148**		
		12	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
		13	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
X		14	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*				

						Thermal bridges - Overview	**Ψ [W/(mK)]**
A	**Thermal bridges Ambient**	15	**167,00**	m	*Units in m*	**Thermal bridges Ambient**	**0,050**
P	**Perimeter thermal bridges**	16	**211,90**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*	**Perimeter thermal bridges**	**0,150**
B	**Thermal bridges FS/BC**	17	**239,60**	m	*Units in m*	**Thermal bridges FS/BC**	**0,150**
I	**Building element towards neigh**	18	**0,00**	m²	*No heat losses, only considered for the heating load calculation*	**Building element towards neighbour**	
Total thermal envelope			**4867,92**	**m²**		**Average therm. envelope**	**0,197**

Go to building components list

23	**stena dvorane proti koridor.**	**8**	External wall - Ambient	**1**	x (	**59,05**	x	**7,80**	+		-		) -	**75,6**	=	385,0	**12ud-Z2 Stena v koridorju**	**0,138**	**240**	**90**	**West**	**0,10**	**0,60**	**0,90**
24	**stena dvorane nad koridor.**	**8**	External wall - Ambient	**1**	x (	**59,05**	x	**2,80**	+		-		) -	**0,0**	=	165,3	**19ud-F2b Fasadna stena telovadnice**	**0,145**	**240**	**90**	**West**	**0,70**	**0,60**	**0,90**
25					x (		x		+		-		) -	**0,0**	=									
26	**stena jedro pritličje SZ**	**8**	External wall - Ambient	**1**	x (	**4,80**	x	**5,55**	+		-	**7,26**	) -	**0,0**	=	19,4	**17ud-F1a Masivna fasadna stena pritličja**	**0,148**	**330**	**90**	**North**	**0,70**	**0,60**	**0,90**
27	**stena jedro nadstropje SZ**	**8**	External wall - Ambient	**1**	x (	**10,20**	x	**26,80**	+	**-6,00**	-	**137,61**	) -	**5,0**	=	124,7	**18ud-F2a Masivna fasadna stena nadstropja**	**0,149**	**330**	**90**	**North**	**0,70**	**0,60**	**0,90**
28	**stena dvorana pritličje SV**	**8**	External wall - Ambient	**1**	x (	**3,90**	x	**56,60**	+		-	**17,40**	) -	**36,8**	=	166,5	**16ud-F1 Lahka fasadna stena telovadnice**	**0,149**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
29	**stena dvorana nadstrop. SV**	**8**	External wall - Ambient	**1**	x (	**3,85**	x	**56,60**	+		-		) -	**145,2**	=	72,7	**18ud-F2a Masivna fasadna stena nadstropja**	**0,149**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
30	**stena dvorana nadstrop. SV**	**8**	External wall - Ambient	**1**	x (	**2,25**	x	**56,60**	+		-		) -	**0,0**	=	127,4	**19ud-F2b Fasadna stena telovadnice**	**0,145**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
31	**stena dvorane pritličje JV**	**8**	External wall - Ambient	**1**	x (	**8,15**	x	**3,50**	+		-		) -	**0,0**	=	28,5	**17ud-F1a Masivna fasadna stena pritličja**	**0,148**	**150**	**90**	**South**	**0,50**	**0,60**	**0,90**
32	**stena dv. vkop. pritličje JV**	**9**	External wall - Ground	**1**	x (	**9,60**	x	**3,50**	+		-		) -	**0,0**	=	33,6	**14ud-Z4 Kletna stena jaška**	**0,151**	**150**	**90**	**South**			
33	**stena dvorane nadstropje JV**	**8**	External wall - Ambient	**1**	x (	**26,70**	x	**6,70**	+		-	**3,96**	) -	**0,0**	=	174,9	**18ud-F2a Masivna fasadna stena nadstropja**	**0,149**	**150**	**90**	**South**	**0,70**	**0,60**	**0,90**
34	**tla na terenu**	**11**	Floor slab / Basement ceiling	**1**	x (	**35,40**	x	**26,70**	+		-		) -	**0,0**	=	945,2	**01ud-P2 Športna dvorana, igrišče**	**0,150**	**60**	**0**	**Hor**			
35	**tla na terenu**	**11**	Floor slab / Basement ceiling	**1**	x (	**21,15**	x	**26,70**	+		-		) -	**0,0**	=	564,7	**03ud-P3 Garderobe, sanitarije, komunikacije, lakirnica**	**0,146**	**60**	**0**	**Hor**			
36	**streha dvorane**	**10**	Roof/Ceiling - Ambient	**1**	x (		x		+	**1509,89**	-		) -	**0,0**	=	1509,9	**06ud-S1 Ravna streha nad telovadnico**	**0,117**	**60**	**0**	**Hor**	**0,80**	**0,60**	**0,90**
37					x (		x		+		-		) -	**0,0**	=									
38	**tla ostalo**	**11**	Floor slab / Basement ceiling	**1**	x (	**6,80**	x	**8,95**	+		-		) -	**0,0**	=	60,9	**02ud-P2a Športna dvorana, ostale površine**	**0,138**	**60**	**0**	**Hor**			
39	**streha ostalo**	**10**	Roof/Ceiling - Ambient	**1**	x (	**6,80**	x	**8,95**	+		-		) -	**0,0**	=	60,9	**09ud-S3 Streha shrambe orodja**	**0,148**	**60**	**0**	**Hor**	**0,10**	**0,60**	**0,90**
40	**zunanja stena ostalo SV**	**8**	External wall - Ambient	**1**	x (	**2,10**	x	**3,50**	+		-	**2,42**	) -	**0,0**	=	4,9	**17ud-F1a Masivna fasadna stena pritličja**	**0,148**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
41	**vkopana stena ostalo SV**	**9**	External wall - Ground	**1**	x (	**4,70**	x	**3,50**	+		-		) -	**0,0**	=	16,5	**11ud-Z1 Kletna stena v terenu**	**0,146**	**60**	**90**	**East**			
42	**vkopana stena ostalo JV**	**9**	External wall - Ground	**1**	x (	**8,95**	x	**3,50**	+		-		) -	**0,0**	=	31,3	**13ud-Z3 Kletna stena**	**0,151**	**150**	**90**	**South**			
43	**vkopana stena ostalo JZ**	**9**	External wall - Ground	**1**	x (	**6,80**	x	**3,50**	+		-		) -	**0,0**	=	23,8	**13ud-Z3 Kletna stena**	**0,151**	**240**	**90**	**West**			
44					x (		x		+		-		) -	**0,0**	=									
45	**P V1**	**7**	Exterior door	**0**	x (	**2,20**	x	**3,30**	+		-		) -	**0,0**	=	0,0	**93ud-Outer door Ud<0,9**	**0,900**	**330**	**90**	**North**	**0,10**	**0,60**	**0,90**
46	**1N V13**	**7**	Exterior door	**1**	x (	**3,00**	x	**2,00**	+		-		) -	**0,0**	=	6,0	**93ud-Outer door Ud<0,9**	**0,900**	**330**	**90**	**North**	**0,70**	**0,60**	**0,90**
47	**P V5**	**7**	Exterior door	**1**	x (	**2,20**	x	**3,30**	+		-		) -	**0,0**	=	7,3	**93ud-Outer door Ud<0,9**	**0,900**	**330**	**90**	**North**	**0,70**	**0,60**	**0,90**
48	**P V18**	**7**	Exterior door	**1**	x (	**2,00**	x	**3,20**	+		-		) -	**0,0**	=	6,4	**93ud-Outer door Ud<0,9**	**0,900**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
49	**P V40 V46**	**7**	Exterior door	**2**	x (	**2,50**	x	**2,20**	+		-		) -	**0,0**	=	11,0	**93ud-Outer door Ud<0,9**	**0,900**	**60**	**90**	**East**	**0,70**	**0,60**	**0,90**
50	**1N V17**	**7**	Exterior door	**1**	x (	**1,80**	x	**2,20**	+		-		) -	**0,0**	=	4,0	**93ud-Outer door Ud<0,9**	**0,900**	**150**	**90**	**South**	**0,70**	**0,60**	**0,90**
51	**P V47**	**7**	Exterior door	**1**	x (	**1,10**	x	**2,20**	+		-		) -	**0,0**	=	2,4	**93ud-Outer door Ud<0,9**	**0,900**	**60**	**90**	**East**	**0,30**	**0,60**	**0,90**

Areas determination

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Summary

Temp.-zone	Area group	Group no.	Area / Length	Unit	Comment	Building assembly overview	Average U-value [W/(m²K)]	Radiation-gains heating season [kWh/a] 8 Months
	Treated floor area	1	**2043,07**	m²	*Treated floor area according to PHPP manual*			
A	**North windows**	2	**5,04**	m²		**North windows**	**0,903**	**248**
A	**East windows**	3	**182,00**	m²	Results come from the 'Windows' worksheet.	**East windows**	**0,871**	**11093**
A	**South windows**	4	**0,00**	m²	Window areas are subtracted from individual opaque areas.	**South windows**		
A	**West windows**	5	**75,60**	m²	which is displayed in the 'Windows' worksheet.	**West windows**	**0,842**	**2372**
A	**Horizontal windows**	6	**0,00**	m²		**Horizontal windows**		
A	**Exterior door**	7	**37,04**	m²	*Please subtract area of door from respective building assembly*	**Exterior door**	**0,900**	
A	**External wall - Ambient**	8	**1269,41**	m²	*Temperature zone "A" is ambient air*	**External wall - Ambient**	**0,145**	**279**
B	**External wall - Ground**	9	**122,56**	m²	*Temperature zone "B" is the ground*	**External wall - Ground**	**0,151**	
A	**Roof/Ceiling - Ambient**	10	**1590,73**	m²		**Roof/Ceiling - Ambient**	**0,118**	**175**
B	**Floor slab / Basement ceiling**	11	**1585,53**	m²		**Floor slab / Basement ceiling**	**0,148**	
		12	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*			
		13	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X			
X		14	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < ft < 1):*			

						Thermal bridges - Overview	**Ψ [W/(mK)]**
A	**Thermal bridges Ambient**	15	**167,00**	m	*Units in m*	**Thermal bridges Ambient**	**0,050**
P	**Perimeter thermal bridges**	16	**211,90**	m	*Units in m; temperature zone "P" is perimeter (see 'Ground' worksheet)*	**Perimeter thermal bridges**	**0,150**
B	**Thermal bridges FS/BC**	17	**239,60**	m	*Units in m*	**Thermal bridges FS/BC**	**0,150**
I	**Building element towards neigh**	18	**0,00**	m²	*No heat losses, only considered for the heating load calculation*	**Building element towards neighbour**	
Total thermal envelope			**4867,92**	**m²**		**Average therm. envelope**	**0,197**

Go to building components list

Thermal bridge inputs

Change order

No.	Thermal bridge - denomination	Group No.	Assigned to group	Quantity	x (	Length [m]	-	Subtraction length [m]	)=	Length ℓ [m]	User determined psi value [W/(mK)]	User determined $f_{Rsi=0,25}$ (optional)	or	Selection building system	Ψ-Value [W/(mK)]	f_{Rsi}-Requirement met?
1	**temelji perimeter**	**16**	Perimeter thermal bridges	**2**	x (	**78,90**	-		) =	157,80	**0,150**		or		**0,150**	
2	**temelji perimeter**	**16**	Perimeter thermal bridges	**2**	x (	**27,05**	-		) =	54,10	**0,150**		or		**0,150**	
3	**temelji znotraj**	**17**	Thermal bridges FS/BC	**3**	x (	**19,10**	-		) =	57,30	**0,150**		or		**0,150**	
4	**temelji znotraj**	**17**	Thermal bridges FS/BC	**5**	x (	**24,70**	-		) =	123,50	**0,150**		or		**0,150**	
5	**temelji znotraj**	**17**	Thermal bridges FS/BC	**3**	x (	**19,60**	-		) =	58,80	**0,150**		or		**0,150**	
6	**atika dvoranski del**	**15**	Thermal bridges Ambient	**2**	x (	**56,70**	-		) =	113,40	**0,050**		or		**0,050**	
7	**atika dvoranski del**	**15**	Thermal bridges Ambient	**2**	x (	**26,80**	-		) =	53,60	**0,050**		or		**0,050**	
8	**atika delavnice**	**15**	Thermal bridges Ambient	**0**	x (	**21,90**	-		) =	0,00	**0,100**		or		**0,100**	
9	**atika delavnice**	**15**	Thermal bridges Ambient	**0**	x (	**21,30**	-		) =	0,00	**0,100**		or		**0,100**	
10					x (		-		) =				or			
11					x (		-		) =				or			
12					x (		-		) =				or			
13					x (		-		) =				or			
14					x (		-		) =				or			
15					x (		-		) =				or			
16					x (		-		) =				or			
17					x (		-		) =				or			
18					x (		-		) =				or			
19					x (		-		) =				or			
20					x (		-		) =				or			
21					x (		-		) =				or			
22					x (		-		) =				or			
23					x (		-		) =				or			
24					x (		-		) =				or			
25					x (		-		) =				or			
26					x (		-		) =				or			
27					x (		-		) =				or			
28					x (		-		) =				or			
29					x (		-		) =				or			
30					x (		-		) =				or			
31					x (		-		) =				or			
32					x (		-		) =				or			
33					x (		-		) =				or			

Windows

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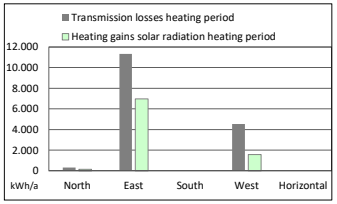
Window area orientation	Global radiation (main orientations)	Shading	Dirt	Non-vertical radiation incidence	Glazing fraction	g-Value	Solar irradiation reduction factor	Window area	Window U-Value	Glazing area	Average global radiation		Transmission losses heating period	Heating gains solar radiation heating period
Standard values →	kWh/(m²a)	0,75	0,95	0,85				m²	W/(m²K)	m²	kWh/(m²a)		kWh/a	kWh/a
North	94	0,92	0,95	0,85	0,71	0,54	0,53	5,04	0,90	3,59	109	North	325	158
East	201	0,91	0,95	0,85	0,71	0,54	0,52	182,00	0,87	128,73	137	East	11315	6964
South	383	1,00	0,95	0,85	0,00	0,00	0,00	0,00	0,00	0,00	383	South	0	0
West	215	0,22	0,95	0,85	0,75	0,54	0,13	75,60	0,84	56,48	294	West	4544	1580
Horizontal	322	1,00	0,95	0,85	0,00	0,00	0,00	0,00	0,00	0,00	322	Horizontal	0	0
Total or average value for all windows.						0,54	0,41	262,64	0,86	188,80			16184	8702



Heating degree hours [kKh/a]: 71,4

Go to glazing list Go to window frames list

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

0,85	1,00	1,10	0,52

Quantity	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Window rough openings: Width	Window rough openings: Height	Installed in: Selection from 'Areas' worksheet	Glazing: Selection from 'Components' worksheet	Frame: Selection from 'Components' worksheet	g-Value: Perpendicular radiation	U-Value: Glazing	U-Value: Frames (avg.)	Ψ Glazing edge ($\Psi_{Glazing\ edge}$) (Avg.)	Installation situation: left	right	bottom	top	$\Psi_{Installation}$ (Avg.)	Results: Window Area	Glazing area	U_w installed	Glazed fraction per window
		°	°		m	m		1-Sorting: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%
0	po7 po6 po5	60	90	East	1,625	1,800	18-stena delavnic SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,13	0,039	0	1	1	1	0,025				
0		60	90	East	1,625	1,800	18-stena delavnic SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,13	0,039	0	0	1	1	0,025				
0		60	90	East	1,625	1,800	18-stena delavnic SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,13	0,039	1	0	1	1	0,025				
0	o13 o14 o15	240	90	West	1,625	1,000	15-stena delavnic proti koridorju	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,14	0,039	0	1	1	1	0,025				
0		240	90	West	1,625	1,000	15-stena delavnic proti koridorju	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,14	0,039	0	0	1	1	0,025				
0		240	90	West	1,625	1,000	15-stena delavnic proti koridorju	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,14	0,04	1	0	1	1	0,025				
2	o12 o12b	330	90	North	1,200	2,100	27-stena jedro nadstropje SZ	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	1	1	1	1	0,025	5,0	3,6	0,9	0,7
4	o4 o3 o2 o1	60	90	East	1,000	2,300	28-stena dvorana pritličje SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	0	1	1	1	0,025	9,2	6,3	0,9	0,7
8		60	90	East	1,000	2,300	28-stena dvorana pritličje SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	0	0	1	1	0,025	18,4	12,6	0,9	0,7
4		60	90	East	1,000	2,300	28-stena dvorana pritličje SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	1	0	1	1	0,025	9,2	6,3	0,9	0,7
11	o11 do o1	60	90	East	1,000	3,300	29-stena dvorana nadstrop. SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,11	0,04	0	1	1	1	0,025	36,3	25,9	0,9	0,7
22		60	90	East	1,000	3,300	29-stena dvorana nadstrop. SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,11	0,04	0	0	1	1	0,025	72,6	51,7	0,9	0,7
11		60	90	East	1,000	3,300	29-stena dvorana nadstrop. SV	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,11	0,04	1	0	1	1	0,025	36,3	25,9	0,9	0,7
6	o18 do o24	240	90	West	1,500	2,100	23-stena dvorane proti koridor.	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	0	1	1	1	0,025	18,9	14,1	0,9	0,7
12		240	90	West	1,500	2,100	23-stena dvorane proti koridor.	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	0	0	1	1	0,025	37,8	28,2	0,8	0,7
6		240	90	West	1,500	2,100	23-stena dvorane proti koridor.	01ud-Trojna zastek. Ug=0.60 g=54%	01ud-Uf < 1,1/1,2	0,54	0,60	1,12	0,04	1	0	1	1	0,025	18,9	14,1	0,9	0,7

Ventilation data

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Treated floor area A_{TFA}	m²	2043		*('Areas' worksheet)*
Room height h	m	6,33	6,33	
Volume of ventilated space (A_{TFA}*h) V_V	m³	12935		*(Worksheet 'Annual heating')*

Ventilation type

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

Infiltration air change rate

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

			For annual demand:	For heating load:				
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	0,60	0,60	12935	m³	1,59	m³/(hm²)

			For annual demand:	For heating load:
Excess extract air		1/h	0,00	0,00
Infiltration air change rate	$n_{V,Rest}$	1/h	**0,042**	**0,105**

Selection of ventilation input - Results

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

	Ventilation unit / Heat recovery efficiency design		Average air flow rate m³/h	Average air change rate 1/h	Extract air excess (extract air system) 1/h	Effective heat recovery efficiency unit [-]	Humidity recovery efficiency [-]	Specific power input Wh/m³	Heat recovery efficiency SHX [-]
x	Standard design	*('Ventilation' worksheet, see below)*	**6000**	**0,46**	**0,00**	**91,8%**	**0,0%**	**0,27**	**0,0%**
	Multiple ventilation units, non-res	*('Addl vent' worksheet)*							

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

Average interior humidity during winter operation

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
35%	35%	41%	49%	-	-	-	-	69%	59%	46%	36%

Extended input for balanced ventilation (at the moment this worksheet is inactive. Calculation takes place in the 'Ventilation' worksheet.)

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Planning ventilation systems with multiple ventilation units

Ventilation unit / Heat recovery efficiency design			
In Ventilation sheet (standard design)		x	*('Ventilation' worksheet)*
In 'Addl vent worksheet (this worksheet)		0,0	*(Addl vent)*
Treated floor area A_{TFA}	m²	2043	*('Areas' worksheet)*
Room height h	m	6,33	*(Worksheet 'Annual heating')*
Room air volume for ventilation (A_{TFA}*h) = V_V	m³	12935	*(Worksheet 'Annual heating')*
Number of occupants	P	150,0	*('Ventilation' worksheet)*
Room temperature	°C	20	*(Worksheet 'Annual heating')*
Average external temp. heating period	°C	4,9	*('Ventilation' worksheet)*
Average ground temp.	°C	11,8	*('Ground' worksheet)*
Length of the heating period	d/a	188	*('Heating' worksheet)*
Ventilation type	1-Balanced PH ventilation with HR		*('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	Annual average value V_{SUP} m³/h	Annual average value V_{ETA} m³/h	Air ch.rt. 1/h	Effective heat recovery efficiency	Humidity recovery efficiency	Spec. input power	Heat recov. efficiency SHX
1	klimat dvorana	15480	15480	2996	2996	---	79%	58%	0,20	0%
2	klimat dvorana jug	19590	19590	3538	3538	---	79%	58%	0,20	0%
3	klimat bar	1320	1320	234	234	---	84%	0%	0,26	0%
4	klimat klub	4050	4050	718	718	---	85%	0%	0,29	0%
5	klimat fitnes	660	660	117	117	---	85%	0%	0,19	0%
6	klimat sanitarije	600	600	106	106	---	80%	0%	0,14	0%
7	klimat plesna	540	540	96	96	---	83%	0%	0,10	0%
8	klimat več. Prostor	450	450	80	80	---	83%	0%	0,10	0%
9	ostali prostori	100	1000	18	177	---	0%	0%	0,10	0%
10						---				
Result for overall vent. syst.										

Recommendations for dimensioning air quantities

Use of low odour and low VOCs building materials/furnishings:
It is strongly recommended to use building materials that cause no or very low VOCs/odours instead of increasing the outdoor air volume in order to clear the air.
This holds true independently from the chosen approach to determine air quality; 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 volumes between 20 to 30 m³/h/person are 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 flushing ventilation is carried out during breaks anyway. For typical outdoor air CO_2 concentrations of around 400-500 ppm, it is possible to comply even with 1500 ppm. Exceeding this figure temporarily is permissible.

Outdoor 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)

Flushing phase for intermittent ventilation operation
In case the ventilation is to be used intermittently (turned off at night), then it should be flushed in the morning, approx. 1 to 2 hours before building is occupied. This should be done in order to refresh air from emissions such as VOCs. Flushing the building causes that the ventilation system works for a longer period (utilisation time + flushing phase). Please consider this at design stage.

Dimensioning of air quantities

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

Room no.	Amount a	Room name	Allocation to ventilation unit (No.)	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 chng. rt. per room n 1/h	Utilisation times h/d h	d/week d	Duration of holidays d	Reduction factor 1	Operation red. 1	Reduction factor 2	Operation red. 2	Reduction factor 3	Operation red. 3	Annual average value: V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Change rate 1/h
1	1	Dvorana - sever	1	952	9,78	9311	15480	15480		1,66	15	7	115	80%	100%					2996	2996		0,32
2	1	Dvorana - jug	2	1152	8,29	9551	19590	19590		2,05	14	7	115	80%	100%					3538	3538		0,37
3	1	bar	3	271	4,22	1142	1320	1320		1,16	11	7	115	100%	100%					234	234		0,21
4	1	klub	4	677	3,00	2030	4050	4050		1,99	11	7	115	100%	100%					718	718		0,35
5	1	fitnes	5	123	3,74	459	660	660		1,44	11	7	115	100%	100%					117	117		0,26
6	1	sanitarije - pritličje	6	162	3,17	514	600	600		1,17	11	7	115	100%	100%					106	106		0,21
7	1	plesna dvorana	7	93	3,00	279	540	540		1,93	11	7	115	100%	100%					96	96		0,34
8	1	večnamenski prosto	8	74	4,20	311	450	450		1,45	11	7	115	100%	100%					80	80		0,26
9	1	ostalo	9	795	3,33	2647	100	1000		0,38	11	7	115	100%	100%					18	177		0,07
10																							
11																							
12																							
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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

Ventilation unit no.	Quantity [-]	Description of ventilation units	Selection of type of ventilation	Design vol. flow per unit m³/h	Application range 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	Application range per line $\Delta p_{External}$ Pa	Subtraction Δp_{Intern} Pa	Interior location (x)	Exterior location (x)	Heat recovery efficiency Unit [-]	Effective [-]	Energy recovery efficiency [-]	Frost protection necessary	Subsoil HX Efficiency of heat recovery	Effective efficiency of heat recovery	Frost protection (electr. / hydr.) Tipe perature	Limit temperature °C	Useful Energy kWh/a
			Change sorting type																				
1	1	klimat dvorana sever	01ud-Klimat dvorana sever	15480	0	18470	0,20	250	250		-	-		x	0,80	79%	58%	N/A		0%	3-Hydraul.	-3	1456
2	1	klimat dvorana jug	02ud-Klimat dvorana jug	19590	0	21230	0,20	250	250		-	-		x	0,80	79%	58%	N/A		0%	3-Hydraul.	-3	1719
3	1	klimat bar	03ud-Klimat bar	1320	0	2085	0,26	200	200		-	-		x	0,87	84%	0%	N/A		0%	3-Hydraul.	-3	114
4	1	klimat klub	04ud-Klimat klub	4050	0	4355	0,29	220	220		-	-		x	0,86	85%	0%	N/A		0%	3-Hydraul.	-3	349
5	1	klimat fitnes	05ud-Klimat fitnes	660	0	890	0,19	220	220		-	-		x	0,86	85%	0%	N/A		0%	3-Hydraul.	-3	57
6	1	klimat sanitarije	06ud-Klimat sanitarije pritličje	600	0	685	0,14	200	200		-	-	x		0,83	80%	0%	N/A		0%	2-Elec.	-3	52
7	1	klimat plesna dvoran	07ud-Klimat plesna dvorana	540	0	500	0,10	200	200		-	-	x		0,84	83%	0%	N/A		0%	2-Elec.	-3	47
8	1	klimat več. Prostor	08ud-Klimat večnamenski prostor 1	450	0	500	0,10	200	200		-	-	x		0,84	83%	0%	N/A		0%	2-Elec.	-3	39
9	1	ostali prostori	09ud-Ostalo	100	0	1000	0,10	0	100		-	-	x		0,00	0%	0%	N/A		0%	1-No		0
10																							0
																						Total (directly electric)	137
																						Total (hydraulic and heat generator)	3695

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, whether the ventilation unit is located indoors or outdoors. The dimensions of these duct sections can be entered here. The heat losses of the overlying duct sections will be considered for the effective heat recovery efficiency.
One section of a duct entered here may also be used for multiple ventilation units.
If in the section "Ventilation unit - selection" (above) 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 installation location: **11,0** (only enter when at least one unit is installed outside of the thermal envelope)

Quantity	Round duct ins. diameter mm	Rectangular duct Width mm	Height mm	Insulation thickness mm	Thermal conductivity W/(m K)	Reflective insulation duct (x)	Duct transmittance W/(m K)	Length of supply air duct m	Outdoor or supply air duct (1)	Exhaust or extract air duct (1)	Duct type	Design volume rate	Assignment to ventilation unit (enter 1 for the corresponding ventilation unit) 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	1200			32	0,04	x	3,034	14,2		1	Extract	15480	1									
1		1500	1500	32	0,04	x	4,256	3,5		1	Extract	15480	1									
1	600			32	0,04	x	1,677	11,1	1		Supply	15480	1									
1	1100			32	0,04	x	2,828	2,5	1		Supply	15480	1									
1		1200	1200	32	0,04	x	3,652	8	1		Supply	15480	1									
1	300			32	0,04	x	0,910	3,4		1	Extract	19590		1								
1	1200			32	0,04	x	3,084	4,2		1	Extract	19590		1								
1		400	300	32	0,04	x	1,292	0,5		1	Extract	19590		1								
1		500	400	32	0,04	x	1,618	1,2		1	Extract	19590		1								
1		1200	1200	32	0,04	x	3,741	6,8		1	Extract	19590		1								
1		2000	1000	32	0,04	x	4,401	1		1	Extract	19590		1								
1	600			32	0,04	x	1,686	11,1	1		Supply	19590		1								
1	1100			32	0,04	x	2,868	2,5	1		Supply	19590		1								
1		400	300	32	0,04	x	1,292	1,5	1		Supply	19590		1								
1		1000	1200	32	0,04	x	3,496	3	1		Supply	19590		1								
1		1200	1200	32	0,04	x	3,741	5,5	1		Supply	19590		1								
1		2000	1000	32	0,04	x	4,401	1	1		Supply	19590		1								
1		400	400	32	0,04	x	1,302	10,8		1	Extract	1320			1							
1		400	400	32	0,04	x	1,302	9,1	1		Supply	1320			1							
1		800	400	32	0,04	x	1,948	12,2		1	Extract	4050				1						
1		800	400	32	0,04	x	1,948	9,3	1		Supply	4050				1						
1		300	200	32	0,04	x	0,871	3,5		1	Extract	660					1					
1		300	200	32	0,04	x	0,871	1,5	1		Supply	660					1					
1	250			32	0,04		0,858	3,2		1	Exhaust	600						1				
1	250			32	0,04		0,858	6,6	1		Outdoor	600						1				
1	200			32	0,04		0,722	1		1	Exhaust	540							1			
1	200			32	0,04		0,722	1	1		Outdoor	540							1			
1	200			32	0,04		0,715	1		1	Exhaust	450								1		
1	200			32	0,04		0,715	1	1		Outdoor air	450								1		
												0										

Specific energy for heating (annual method)

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Interior temperature: 20,0 °C
Building type: Športna dvorana
Treated floor area A_{TFA}: 2043,1 m²

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Temp. factor f_t		G_t kKh/a		kWh/a	Per m² of treated floor area
External wall - Ambient	A	1269,4	*	0,145	*	1,00	*	71,4	=	13095	6,41
External wall - Ground	B	122,6	*	0,151	*	0,37	*	71,4	=	492	0,24
Roof/Ceiling - Ambient	A	1590,7	*	0,118	*	1,00	*	71,4	=	13437	6,58
Floor slab / Basement ceiling	B	1585,5	*	0,148	*	0,37	*	71,4	=	6264	3,07
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,00	*		=		
Windows	A	262,6	*	0,863	*	1,00	*	71,4	=	16184	7,92
Exterior door	A	37,0	*	0,900	*	1,00	*	71,4	=	2379	1,16
Exterior TB (length/m)	A	167,0	*	0,050	*	1,00	*	71,4	=	596	0,29
Perimeter TB (length/m)	P	211,9	*	0,150	*	0,37	*	71,4	=	848	0,41
Ground TB (length/m)	B	239,6	*	0,150	*	0,37	*	71,4	=	959	0,47
Total of all building envelope areas		4867,9									kWh/(m²a)
Transmission heat losses Q_T									Total	54254	26,6

		A_{TFA} m²		Clear room height m		m³		
Ventilation system:	Effective air volume, V_V	2043,1	*	6,33	=	12935,4		
Effective heat recovery efficiency	η_{eff} 92%							
Efficiency of subsoil heat exchanger								
Heat recovery efficiency of SHX	η_{SHX} 0%							

	$n_{V,system}$ 1/h		η_{HR}		$n_{V,Res}$ 1/h		1/h		
Energetically effective air changes nV	0,464	* (1 -	0,92	) +	0,042	=	0,080		

	V_V m³		n_V 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation heat losses Q_V	12935,4	*	0,080	*	0,33	*	71,4	=	24445	12,0

	Q_T kWh/a		Q_V kWh/a		Reduction factor night/weekend Saving		kWh/a	kWh/(m²a)
Total heat losses Q_L	(54254	+	24445	)	1,0	=	78699	**38,5**

Orientation of the area	Reduction factor See 'Windows' sheet		g-Value (perp. radiation)		Area m²		Radiation HP kWh/(m²a)		kWh/a
North	0,53	*	0,54	*	5,04	*	109	=	158
East	0,52	*	0,54	*	182,00	*	137	=	6964
South	0,00	*	0,00	*	0,00	*	383	=	0
West	0,13	*	0,54	*	75,60	*	294	=	1580
Horizontal	0,00	*	0,00	*	0,00	*	322	=	0
Available solar heat gains Q_S								Total	8702	kWh/(m²a) 4,3

	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	*	188	*	2,10	*	2043,1	=	19318	9,5

		kWh/a	kWh/(m²a)
Free heat Q_F	$Q_S + Q_I$ =	28020	13,7
Ratio of free heat to losses	Q_F / Q_V =	0,36	
Utilisation factor heat gains h_G	$(1 - (Q_F / Q_L)^5) / (1 - (Q_F / Q_L)^6)$ =	100%	
Heat gains Q_G	$\eta_G * Q_F$ =	27917	**13,7**

		kWh/a	kWh/(m²a)
Annual heating demand Q_H	$Q_L - Q_G$ =	50782	**25**

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

Specific energy for heating (monthly method)

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

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

Interior temperature:	20	°C
Building type:	Športna dvorana	
Treated floor area A_{TFA}:	2043,1	m²
Spec. Capacity:	204	Wh/(m²K)

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Month. red. fac.		G_t kKh/a		kWh/a	Per m² of treated floor area
External wall - Ambient	A	1269,4	*	0,145	*	1,00	*	81	=	14850	7,27
External wall - Ground	B	122,6	*	0,151	*	1,00	*	33	=	613	0,30
Roof/Ceiling - Ambient	A	1590,7	*	0,118	*	1,00	*	81	=	15238	7,46
Floor slab / Basement ceiling	B	1585,5	*	0,148	*	1,00	*	33	=	7798	3,82
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,00	*		=		
Windows	A	262,6	*	0,863	*	1,00	*	81	=	18354	8,98
Exterior door	A	37,0	*	0,900	*	1,00	*	81	=	2698	1,32
Exterior TB (length/m)	A	167,0	*	0,050	*	1,00	*	81	=	676	0,33
Perimeter TB (length/m)	P	211,9	*	0,150	*	1,00	*	33	=	1055	0,52
Ground TB (length/m)	B	239,6	*	0,150	*	1,00	*	33	=	1193	0,58
											kWh/(m²a)
Transmission heat losses Q_T									Total	62474	30,6

	A_{TFA} m²		Clear room height m		m³
Effective air volume V_V	2043	*	6,33	=	12935

	$n_{V,system}$ 1/h		η*SHX		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective air change rate Ambient nV,e	0,464	*(1-	0%	)*(1-	0,92	)+	0,042	=	0,080
Effective air change rate Ground nV,g	0,464	*	0%	*(1-	0,92	)		=	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	12935	*	0,080	*	0,33	*	81	=	27722	13,6
Ventilation losses ground $Q_{V,e}$	12935	*	0,000	*	0,33	*	47	=	0	0,0
Ventilation heat losses Q_V								Total	27722	13,6

	Q_T kWh/a		Q_V kWh/a		Reduction factor night/weekend saving		kWh/a	kWh/(m²a)
Total heat losses Q_L	(62474	+	27722	) *	1,0	=	90196	**44,1**

Orientation of the area	Reduction factor see 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a
North	0,53	*	0,54	*	5,0	*	172	=	248
East	0,52	*	0,54	*	182,0	*	218	=	11093
South	0,00	*	0,00	*	0,0	*	546	=	0
West	0,13	*	0,54	*	75,6	*	441	=	2372
Horizontal	0,00	*	0,00	*	0,0	*	509	=	0
Sum opaque areas									3352
									kWh/(m²a)
Available solar heat gains Q_S								Total	17064	8,4

	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	*	242	*	2,1	*	2043,1	=	24919	12,2

			kWh/a	kWh/(m²a)
Free heat Q_F	Q_S + Q_I	=	41983	20,5
Ratio free heat to losses	Q_F / Q_L	=	0,47	
Utilisation factor heat gains h_G		=	96%	
Heat gains Q_G	η_G * Q_F	=	40158	**19,7**

			kWh/a	kWh/(m²a)
Annual heating demand Q_H	Q_L - Q_G	=	50038	**24**

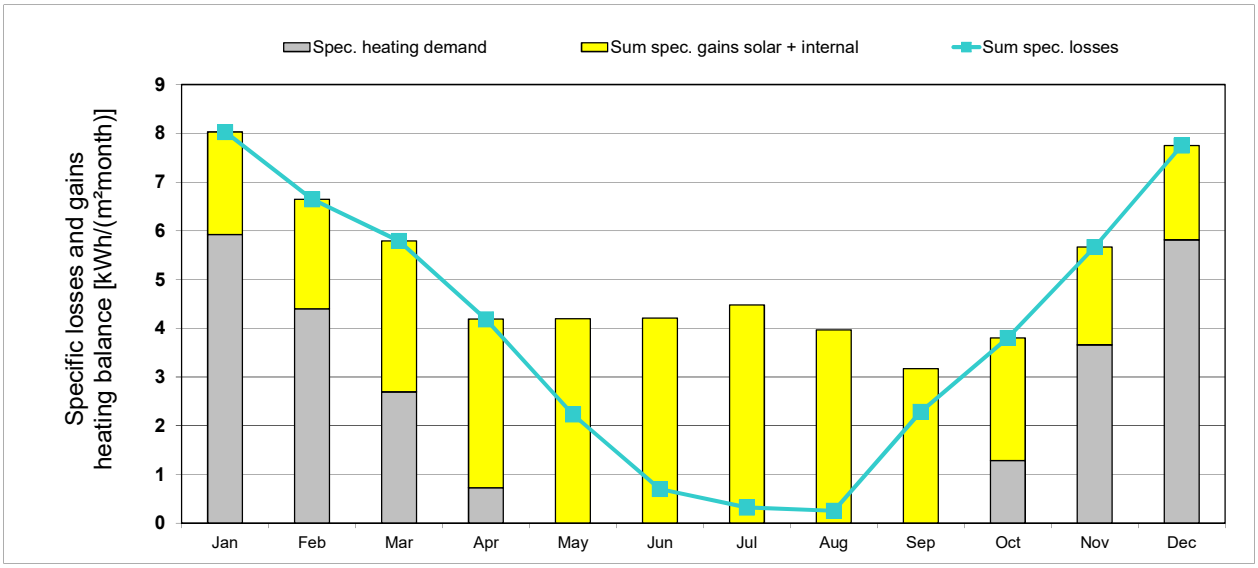
	kWh/(m²a)		(Yes/No)
Limiting value	-	**Requirement met?**	-

Specific energy for heating (monthly method)

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Interior temperature: 20 °C
Building type: Športna dvorana
Treated floor area A_{TFA}: 2043 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - Externa	15,2	12,4	10,5	7,3	3,3	0,6	-0,1	-0,2	3,7	6,7	10,5	14,7	84	kKh
Heating degree hours - Ground	4,6	4,3	4,7	4,4	4,2	2,6	2,4	2,2	3,4	3,7	3,8	4,3	45	kKh
Losses - Exterior	14928	12202	10309	7132	3199	598	-113	-206	3587	6587	10344	14449	83015	kWh
Losses - Ground	1476	1378	1519	1412	1361	836	772	722	1081	1177	1233	1384	14350	kWh
Sum spec. losses	8,0	6,6	5,8	4,2	2,2	0,7	0,3	0,3	2,3	3,8	5,7	7,7	47,7	kWh/m²
Solar gains - North	14	25	42	61	77	80	81	70	46	32	17	11	556	kWh
Solar gains - East	658	1087	2130	2733	3842	3938	4276	3406	2272	1199	576	439	26555	kWh
Solar gains - South	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - West	214	259	373	449	498	496	533	524	424	311	195	147	4424	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	233	339	586	750	963	994	1064	911	648	409	222	164	7284	kWh
Internal heat gains	3192	2883	3192	3089	3192	3089	3192	3192	3089	3192	3089	3192	37584	kWh
Sum spec. gains solar + intern	2,1	2,2	3,1	3,5	4,2	4,2	4,5	4,0	3,2	2,5	2,0	1,9	37,4	kWh/m²
Utilisation factor	100%	100%	100%	100%	53%	17%	7%	6%	72%	100%	100%	100%	62%	
Annual heating demand	12093	8987	5505	1476	0	0	0	0	1	2619	7478	11879	50038	kWh
Spec. heating demand	**5,9**	**4,4**	**2,7**	**0,7**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**1,3**	**3,7**	**5,8**	**24,5**	kWh/m²



Annual heating demand: Comparison

Monthly method	('Heating')	50038	kWh/a	24,5	**kWh/(m²a)** reference to treated floor area according to PHPP
Annual method	('Annual heati	50782	kWh/a	24,9	**kWh/(m²a)** reference to treated floor area according to PHPP
		-	kWh/a	-	

Heating load

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Interior temperature: 20 °C
Building type: Športna dvorana
Treated floor area A_{TFA}: 2043,1 m²

	Design temperature		Radiation:	North	East	South	West	Horizontal	
Weather 1:	-6,8	°C		11	29	88	32	41	W/m²
Weather 2:	-5,9	°C		8	9	39	29	23	W/m²
Ground design temp.	13,6	°C							

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Factor always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		PT 1 W		PT 2 W
External wall - Ambient	A	1269,4	*	0,145	*	1,00	*	26,8	or	25,9	=	4917	or	4752
External wall - Ground	B	122,6	*	0,151	*	1,00	*	6,4	or	6,4	=	118	or	118
Roof/Ceiling - Ambient	A	1590,7	*	0,118	*	1,00	*	26,8	or	25,9	=	5046	or	4876
Floor slab / Basement ceiling	B	1585,5	*	0,148	*	1,00	*	6,4	or	6,4	=	1500	or	1500
	A		*		*	1,00	*	26,8	or	25,9	=		or	
	A		*		*	1,00	*	26,8	or	25,9	=		or	
	X		*		*	0,00	*	26,8	or	25,9	=		or	
Windows	A	262,6	*	0,863	*	1,00	*	26,8	or	25,9	=	6077	or	5873
Exterior door	A	37,0	*	0,900	*	1,00	*	26,8	or	25,9	=	893	or	863
Exterior TB (length/m)	A	167,0	*	0,050	*	1,00	*	26,8	or	25,9	=	224	or	216
Perimeter TB (length/m)	P	211,9	*	0,150	*	1,00	*	6,4	or	6,4	=	203	or	203
Ground TB (length/m)	B	239,6	*	0,150	*	1,00	*	6,4	or	6,4	=	229	or	229
Building element towards neighbour	I		*		*	1,00	*	3,0	or	3,0	=		or	

Transmission heat load P_T

Total = 19207 or 18631

Ventilation system:

Effective air volume, V_V: A_{TFA} 2043,1 m² * Clear room height 6,33 m = 12935 m³

Heat recovery efficiency of the heat exchanger η_{HR} 92%
Heat recovery efficiency SHX 0%
Heat recovery efficiency SHX $\eta_{SHX\ 1}$ 0% or $\eta_{SHX\ 2}$ 0%

Energetically effective air changes n_V: $n_{V,Res}$ (Heating Load) 0,105 1/h + $n_{V,system}$ 0,464 1/h *(1- Φ_{HP} 0,92 or Φ_{HP} 0,92) = 0,143 1/h or 0,143 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
12935,4	*	0,143	or	0,143	*	0,33	*	26,8	or	25,9	=	16387	or	15836

Total heating load P_L

$P_T + P_V$ = PL 1 35594 W or PL 2 34468 W

Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
North	5,0	*	0,5	*	0,53	*	12	or	14	=	18	or	20
East	182,0	*	0,5	*	0,52	*	15	or	4	=	747	or	189
South	0,0	*	0,0	*	0,40	*	88	or	39	=	0	or	0
West	75,6	*	0,5	*	0,13	*	56	or	37	=	300	or	197
Horizontal	0,0	*	0,0	*	0,40	*	41	or	23	=	0	or	0

Solar heating power P_S

Total = 1065 or 405

Internal heating load P_I

Spec. power 1,6 W/m² * A_{TFA} 2043 m² = P_I 1 3269 W or P_I 2 3269 W

Heating power (gains) P_G

$P_T + P_I$ = P_G 1 4334 W or P_G 2 3674 W

$P_L - P_G$ = 31261 or 30793

Heating load P_H = 31261 W

Area specific space heating load P_H / A_{TFA} = 15,3 W/m²

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

Supply air temperature without heating $\vartheta_{Supply,Min}$ 17,8 °C or 17,9 °C

For comparison: heating load transportable by the supply Air $P_{Supply\ Air,Max}$ = 67735 W specific: 33,2 W/m²

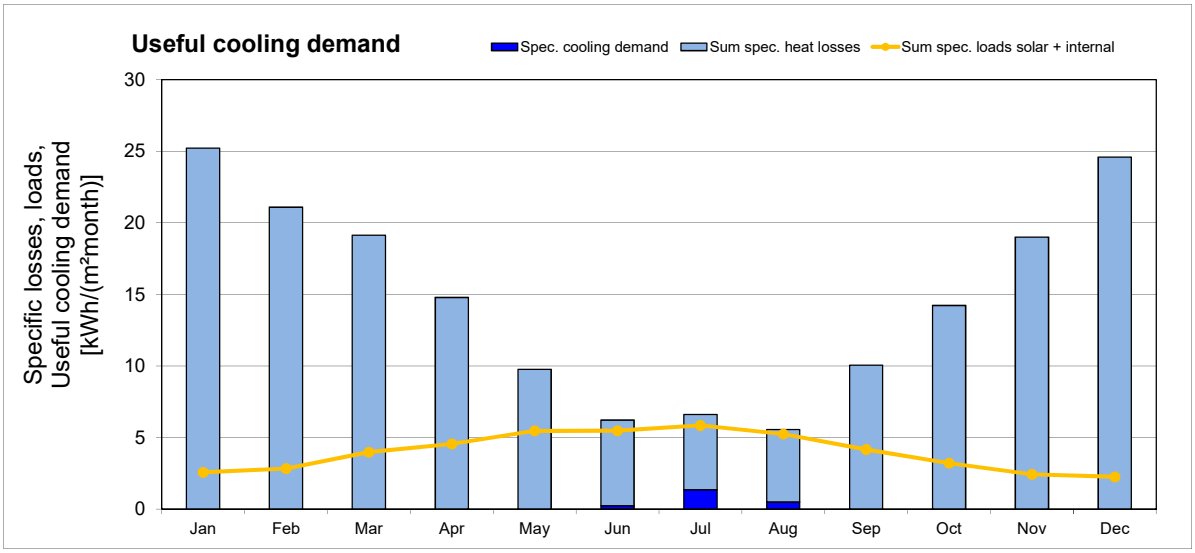
Supply air heating: Sufficient? (Yes/No) Yes

Cooling: energy value for useful cooling energy

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Interior Temperature: 25 °C
Building type: Športna dvorana
Treated Floor Area A_{TFA}: 2043 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - Exterior	19,1	16,0	14,4	11,0	7,2	4,4	3,8	3,7	7,4	10,6	14,3	18,6	130	kKh
Heating degree hours - Ground	8,3	7,7	8,5	8,0	8,0	6,2	6,1	6,0	7,0	7,4	7,4	8,0	88	kKh
Losses - Exterior	41451	34499	30953	23555	14934	8843	7516	7304	15655	22731	30944	40420	278806	kWh
Losses - Ground	2406	2213	2445	2314	2302	1794	1771	1727	2015	2136	2153	2323	25598	kWh
Losses summer ventilation	7671	6372	5699	4323	2711	1580	1422	1321	2862	4190	5724	7486	51359	kWh
Sum spec. heat losses	25,2	21,1	19,1	14,8	9,8	6,0	5,2	5,1	10,0	14,2	19,0	24,6	174,1	kWh/m²
Solar load North	16	28	48	70	89	93	93	80	53	37	19	13	640	kWh
Solar load East	769	1271	2492	3196	4494	4606	5002	3983	2657	1403	674	513	31059	kWh
Solar load South	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load West	1038	1255	1808	2177	2416	2406	2584	2542	2055	1510	943	714	21446	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	233	339	586	750	963	994	1064	911	648	409	222	164	7284	kWh
Internal heat gains	3192	2883	3192	3089	3192	3089	3192	3192	3089	3192	3089	3192	37584	kWh
Sum spec. loads solar + internal	2,6	2,8	4,0	4,5	5,5	5,5	5,8	5,2	4,2	3,2	2,4	2,2	48,0	kWh/m²
Utilisation factor losses	10%	13%	21%	31%	56%	88%	86%	94%	41%	23%	13%	9%	27%	
Useful cooling energy demand	0	0	0	0	5	481	2774	1002	0	0	0	0	4261	kWh
Spec. cooling demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	**1,4**	**0,5**	**0,0**	**0,0**	**0,0**	**0,0**	**2,1**	kWh/m²
Specif. dehumidification demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,6**	**1,0**	**0,0**	**0,0**	**0,0**	**0,0**	**1,6**	kWh/m²
Sensible fraction	100%	100%	100%	100%	100%	100%	69%	32%	100%	100%	100%	100%	56%	



Cooling: energy value for useful cooling energy

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

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

Building type:	Športna dvorana		Treated floor area A_{TFA}:	2043,1	m²
Interior temperature summer:	25	°C	Building volume:	12935	m³
Nominal humidity:	12	g/kg	Internal humidity sources:	7,3	g/(m²h)
Spec. capacity:	204	Wh/(m²K)			

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Mon. red. fac.		G_t kKh/a		kWh/a	per m² treated floor area
External wall - Ambient	A	1269,4	*	0,145	*	1,00	*	26	=	4849	2,37
External wall - Ground	B	122,6	*	0,151	*	1,00	*	33	=	613	0,30
Roof/Ceiling - Ambient	A	1590,7	*	0,118	*	1,00	*	26	=	4975	2,44
Floor slab / Basement ceiling	B	1585,5	*	0,148	*	1,00	*	33	=	7803	3,82
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,00	*		=		
Windows	A	262,6	*	0,863	*	1,00	*	26	=	5993	2,93
Exterior door	A	37,0	*	0,900	*	1,00	*	26	=	881	0,43
Exterior TB (length/m)	A	167,0	*	0,050	*	1,00	*	26	=	221	0,11
Perimeter TB (length/m)	P	211,9	*	0,150	*	1,00	*	26	=	840	0,41
Ground TB (length/m)	B	239,6	*	0,150	*	1,00	*	33	=	1194	0,58
											kWh/(m²a)
Transmission losses Q_T (negative: heat loads)									Total	27368	13,4

Summer ventilation

from 'SummVent' worksheet

Ventilation conductance, vent. unit

exterior $H_{V,e}$	112,6	W/K
without HR	1366,0	W/K
ground $H_{V,g}$	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

exterior	179,3	W/K

Ventilation parameter

Temperature amplitude summer	9,9	K
Minimum acceptable indoor temperature	22,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air changes	0,32	1/h
Outdoor air changes	0,04	1/h
Window night vent. air change rate, manual @ 1K	0,00	1/h
Air changes rate due to mech., autom. controlled vent.	0,10	1/h
Specific power consumption for	0,21	Wh/m³
η_{HR}	92%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

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

	$n_{V,system}$ 1/h		η-SHX		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h
Hygienic air change									
Effective air change rate Ambient $n_{V,e}$	0,320	*(1-	0%	)*(1-	0,01	)+	0,042	=	0,360
Effective air change rate Ground $n_{V,g}$	0,320	*	0%	*(1-	0,01	)		=	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	12935	*	0,360	*	0,33	*	24	=	36494	17,9
Ventilation losses ground $Q_{V,e}$	12935	*	0,000	*	0,33	*	0	=	0	0,0
Heat losses summer ventilation	12935	*	0,090	*	0,33	*	26	=	9896	4,8
Ventilation heat losses Q_V								Total	46390	22,7

	Q_T kWh/a		Q_V kWh/a		kWh/a	kWh/(m²a)
Total heat losses Q_L	27368	+	46390	=	73758	**36,1**

Orientation of the area	Reduction factor		g-Value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a
North	0,61	*	0,54	*	5,0	*	245	=	407
East	0,60	*	0,54	*	182,0	*	349	=	20741
South	0,40	*	0,00	*	0,0	*	436	=	0
West	0,64	*	0,54	*	75,6	*	460	=	12002
Horizontal	0,40	*	0,00	*	0,0	*	737	=	0
Sum opaque areas									4581
									kWh/(m²a)
Available solar heat gains Q_S								Total	37731	18,5

	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	*	153	*	2,1	*	2043,1	=	15755	7,7

		kWh/a	kWh/(m²a)
Sum heat loads Q_F	Q_S + Q_I =	53486	**26,2**

Ratio of losses to free heat gains	Q_L / Q_F =	1,38	
Utilisation factor heat losses η_G	=	67%	
		kWh/a	kWh/(m²a)
Useful heat losses $Q_{V,n}$	η_G * Q_L =	49225	**24,1**
		kWh/a	kWh/(m²a)
Useful cooling demand Q_K	Q_F - $Q_{V,n}$ =	4261	**2**

	kWh/(m²a)		(Yes/No)
Recommended maximum value	15	**Requirement met?**	Yes

-

Summer ventilation

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Building volume:	12935	m³	Building type:	Športna dvorana	
Max. indoor absolute humidity:	12	g/kg	Heat recovery efficiency:	92%	
Internal humidity sources:	100	g/(P*h)	Humidity recovery efficiency:	0%	
			Subsoil heat exchanger efficiency:	0%	

Results passive cooling			Results active cooling		
Frequency of overheating:	10,8%	at the overheating limit ϑ_{max} = 25 °C	Useful cooling demand:	2,1	kWh/(m²a)
max. humidity:	14,9	g/kg	Dehumidification demand:	1,6	kWh/(m²a)
Frequency of exceeded humidity:	13,4%		Frequency of exceeded humidity:	0,0%	

Summer basic ventilation to ensure adequate air quality

Air change rate via vent. system with supply a: 0,32 1/h

HRV/ERV in summer (check only one field)

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

Air change rate via extract air system: 1/h

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

Window ventilation air change rate: 1/h

Effective air change rate

	$n_{V,system}$ 1/h		$\eta*_{SHX}$		η_{HP}		$n_{V,equi,fraction}$ 1/h
Exterior $n_{V,e}$	0,320	*(1-	0%	)*(1-	0,92	) =	0,026
without HR	0,320	*(1-	0%	)		=	0,320
Ground $n_{L,g}$	0,320	*	0%	*(1-	0,92	) =	0,000
without HR	0,320	*	0%			=	0,000

Ventilation conductance

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)			
exterior $H_{V,e}$	12935	*	0,026	*	0,33	=	112,6	W/K
without HR	12935	*	0,320	*	0,33	=	1366,0	W/K
ground $H_{V,g}$	12935	*	0,000	*	0,33	=	0,0	W/K
without HR	12935	*	0,000	*	0,33	=	0,0	W/K
Infiltration, window, extract air system	12935	*	0,042	*	0,33	=	179,3	W/K

Additional summer ventilation for cooling

Additional ventilation regulation

Minimum acceptable indoor temp.: 22,0 °C

Type of additional ventilation

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

Mechanical, automatically Controlled ventilation

Corresponding air change rate during operation, in addition to basic air change: 0,10 1/h

Specific power consumption: 0,21 Wh/m³

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

Compressor - cooling units

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Building type:	Športna dvorana		Treated floor area A_{TFA}:	2043,1	m²
Interior temperature summer:	25,0	°C	Mechanical cooling:	x	
Nominal humidity:	12,0	g/kg	Air change rate via ventilation system with supply air:	0,3	
Internal humidity sources:	7,3	g/(m²h)			

x Supply air cooling

check as appropriate

On/Off mode (check as appropriate)		
Max. cooling capacity (sensible + latent)	70,0	kW
Temperature reduction dry	49,7	K
Seasonal energy efficiency ratio	3,0	

x Recirculation cooling

check as appropriate

On/Off mode (check as appropriate)	x	
Max. cooling capacity (sensible + latent)	30,0	kW
Volume flow rate at nominal power	10000	m³/h
Temperature reduction dry	8,8	K
Variable air volume (check if appropriate)		
Seasonal energy efficiency ratio	2,97	

x Additional dehumidification

check as appropriate

Waste heat to room (check if appropriate)	x	
Seasonal energy efficiency ratio	3,0	

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	2,1		1,6					56%
Cooling contribution by:								
Supply air cooling	(2,1	+	0,1	) /	3,0	=	0,7	97%
Recirculation cooling	(0,0	+	0,0	) /	3,0	=	0,0	0%
Dehumidification			1,6	/	2,2	=	0,7	0%
Remaining for panel cooling				/	0,0	=		100%
Cooling distribution	0,6			/	3,0	=	0,2	100%
Total	(**2,7**	+	**1,6**	) /	2,6	=	**1,6**	62%

			(Yes/No)
Unsatisfied demand	0,0	0,0	**Cooling demand covered?** **Yes**

Cooling load

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Building type: Športna dvorana

Treated floor area A_{TFA}:	2043,1	m²	Spec. capacity:	204	Wh/(m²
Building volume:	12935	m³	Nominal humidity:	12,0	g/kg
Interior temperature:	25	°C	Internal humidity sources:	7,3	g/(m²h)

Temperature:	Outdoor air		Dew point		Sky	
Weather 1:	25,9	°C	17,6	°C	15,2	°C
Weather 2:	25,9	°C	17,6	°C	17,6	°C
Ground design temp.	17,0	°C	SHX		11,8	°C

Radiation:	North	East	South	West	Horizontal	
	47	114	131	124	203	W/m²
	47	114	131	124	203	W/m²

Building assembly	Temperature zone	Area m²		U-Value W/(m²K)		Factor always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
External wall - Ambient	A	1269,4	*	0,145	*	1,00	*	0,9	or	0,9	=	165	or	165
External wall - Ground	B	122,6	*	0,151	*	1,00	*	-8,0	or	-8,0	=	-148	or	-148
Roof/Ceiling - Ambient	A	1590,7	*	0,118	*	1,00	*	0,9	or	0,9	=	169	or	169
Floor slab / Basement ceiling	B	1585,5	*	0,148	*	1,00	*	-8,0	or	-8,0	=	-1884	or	-1884
	A		*		*	1,00	*	0,9	or	0,9	=		or	
	A		*		*	1,00	*	0,9	or	0,9	=		or	
	X		*		*	0,00	*	0,9	or	0,9	=		or	
Windows	A	262,6	*	0,863	*	1,00	*	0,9	or	0,9	=	204	or	204
Exterior door	A	37,0	*	0,900	*	1,00	*	0,9	or	0,9	=	30	or	30
Exterior TB (length/m)	A	167,0	*	0,050	*	1,00	*	0,9	or	0,9	=	8	or	8
Perimeter TB (length/m)	P	211,9	*	0,150	*	1,00	*	-8,0	or	-8,0	=	-255	or	-255
Ground TB (length/m)	B	239,6	*	0,150	*	1,00	*	-8,0	or	-8,0	=	-288	or	-288
Building element towards neighbour	I		*		*	1,00	*	3,0	or	3,0	=		or	
Radiation correction outdoor air				$L_{ambient}$ W/K		-47,5	*	0,9	or	0,9	=	-43	or	-43
Radiation correction sky				L_{Sky} W/K		46,6	*	-9,8	or	-7,4	=	-455	or	-345
Transmission heat load P_T										Total	=	**-2497**	or	**-2387**

Ventilation load	V_V m³		$n_{V,equi,fraction}$ 1/h		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
Exterior $P_{V,o}$	12935	*	0,068	or	0,068	*	0,33	*	0,9	or	0,9	=	263	or	263
Ground $P_{L,e}$	12935	*	0,000	or	0,000	*	0,33	*	-13,2	or	-13,2	=	0	or	0
Summer ventilation $P_{L,S}$	12935	*	0,043	or	0,043	*	0,33	*	-2,6	or	-2,6	=	-477	or	-477
Ventilation heat load P_V												Total	**-214**	or	**-214**

Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
North	5,0	*	0,5	*	0,61	*	63	or	63	=	104	or	104
East	182,0	*	0,5	*	0,60	*	86	or	86	=	5121	or	5121
South	0,0	*	0,0	*	0,40	*	131	or	131	=	0	or	0
West	75,6	*	0,5	*	0,64	*	137	or	137	=	3568	or	3568
Horizontal	0,0	*	0,0	*	0,40	*	203	or	203	=	0	or	0
Sum opaque areas											1254	or	1254
Solar load P_S									Total	=	**10048**	or	**10048**

Internal heating load P_I	Spec. power W/m²		A_{TFA} m²	=	P_I 1 W		P_I 2 W
	2,1	*	2043	=	**4290**	or	**4290**

$P_T + P_V + P_S + P_I$	=	11627	or	11737
Cooling load P_C	=	**11737**		**W**
Area specific cooling load P_C / A_{TFA}	=	**5,7**		**W/m²**

		°C		°C
Please enter the minimum supply air temperature. 18 °C — Supply air temperature without cooling $\vartheta_{Supply,Min}$		25,1		25,1
		W		W
For comparison: cooling load, transportable through the supply air $P_{Supply;Max}$	=	**9663**		**9663**
		W/m²		W/m²
	specific:	4,7		4,7

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

Daily internal temperature stroke

	Transmission W		Ventilation W		Solar load W		Time h/d		Spec. capacity Wh/(m²K)		A_{TFA} m²		
(	-2387,3	+	-214,2	+	10047,6	) *	24	/ (	204	*	2043	) =	**0,4** K

Dehumidific. load

from 'Cooling' worksheet

Absolute humidity exterior air	12,6	or	12,6	g/kg	Absolute humid. supply air	12,6	or	12,6	g/kg
Outdoor air mass flow	641	or	641	kg/h	Supply air mass flow	4884	or	4884	kg/h
Summer vent. air mass flow	674	or	674	kg/h	**Humid. load, supply air**	2969	or	2969	g/h
Humidity load, outdoor air	800	or	800	g/h	**Humidity load, internal**	15000	or	15000	g/h

	Enthalpy of vaporisation Wh/kg		g/kg		Humidity load g/h		Humidity load g/h		P_D 1 W		P_D 2 W
	707,639	/	1000	*	18769	or	18769	=	**13281**	or	**13281**
Dehumidification load P_T								=	**13281**		**W**
Area specific dehumidification load P_T / A_{TFA}								=	**6,5**		**W/m²**

Monthly average values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Specific cooling demand	0,0	0,0	0,0	0,0	0,0	0,2	1,4	0,5	0,0	0,0	0,0	0,0	kWh/m²
Specific dehumidification demand	0,0	0,0	0,0	0,0	0,0	0,0	0,6	1,0	0,0	0,0	0,0	0,0	kWh/m²
Sensible fraction	100%	100%	100%	100%	100%	100%	69%	32%	100%	100%	100%	100%	

Minimum of sensible cooling load fraction occurred **32%**

Primary Energy Renewable PER

Energy balance calculation with PHPP Version 9.6a

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

Building type:	Športna dvorana	
Treated floor area A_{TFA}:	2043	m²
Projected building footprint $A_{Projected}$:	1588	m²
Heating demand incl. distribution & hydr. frost protection	25	kWh/(m²a)
Cooling energy dem. incl. dehumidification	4	kWh/(m²a)
DHW demand including distribution:	13	kWh/(m²a)

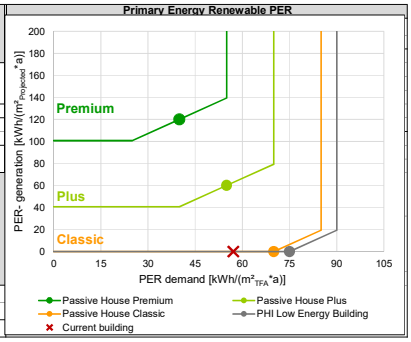
Selection of heat generation system(s)	Contribution margin (useful energy)			
Primary heat generation type	Heating	DHW	Addl. input in following worksheets	
3-District heating, CGS	100%	65%	District heat	
Secondary heat generation type (optional & different)				
2-Heat pump(s)	0%	35%	HP, possibly HP ground	

Energy demand Reference: Treated floor area	Efficiency		Final energy		PER			PE		CO_2	
	Calculation	User defined value	Contribution (final energy)	Final energy demand	PER factor	Effective PER factor (including biomass	PER specific value	PE factor	PE value	CO_2 emissions factor (CO_2-eq)	CO_2eq emissions
	-	-		kWh/(m²a)	kWh/kWh	kWh/kWh	kWh/(m²a)	kWh/kWh	kWh/(m²a)	kg/kWh	kg/(m²a)
								8-PE factors user determined		2-CO2 factors user determined	
							57,2		39,9		8,5
Heating			100%			1,05	**32,3**	0,35	**10,8**		**2,3**
Electricity (HP compact unit)					1,85			2,50		0,530	
Electricity (heat pump)					1,85			2,50		0,530	
District heating: 21-Gas CHP (small) 35% CHP	0,95		100%	26,5	0,85|1,43|1	0,92	24,3	0,00	0,0	0,000	0,0
Wood and other biomass					1,10			-		-	
Natural gas / RE gas					1,75			1,10		0,200	
Heating oil / RE methanol					2,30			1,10		0,280	
Solar thermal system											
Electricity (direct)					1,85			2,50		0,530	
Other											
Aux. electricity (heating, wintertime ventilation)				4,3	1,85	1,85	8,0	2,50	10,8	0,530	2,3
Cooling and dehumidification					1,20		**5,1**		**10,7**		**2,3**
Electricity cooling (heat pump)	2,97			0,9	1,15		1,1	2,50	2,3	0,530	0,5
Auxiliary electricity cooling, ventilation summer				2,5	1,15		2,9	2,50	6,4	0,530	1,4
Electricity dehumidification (heat pump)	2,21			0,7	1,40		1,0	2,50	1,8	0,530	0,4
Auxiliary electricity (dehumidification)				0,1	1,40		0,1	2,50	0,2	0,530	0,0
DHW generation			100%			1,16	**13,7**	0,58	**6,8**		**1,4**
Electricity (HP compact unit)					1,30			2,50		0,530	
Electricity (heat pump)	1,90		35%	2,5	1,30	1,30	3,2	2,50	6,2	0,530	1,3
District heating: 21-Gas CHP (small) 35% CHP	0,95		65%	9,1	0,85|1,43|1	1,11	10,2	0,00	0,0	0,000	0,0
Wood and other biomass					1,10			-		-	
Natural gas / RE gas					1,75			1,10		0,200	
Heating oil / Methanol					2,30			1,10		0,280	
Solar thermal system											
Electricity (direct)					1,30			2,50		0,530	
Other											
Aux. electricity (DHW + solar DHW)				0,3	1,30	1,30	0,4	2,50	0,7	0,530	0,1
Household electricity				4,7		1,30	**6,0**		**11,6**		**2,5**
Electricity (household or non-residential lighting, etc.)				4,7	1,30	1,30	6,0	2,50	11,6	0,530	2,5
Auxiliary electricity (other)					1,30			2,50		0,530	
Gas / RE gas dry/cook				**0,0**	1,75		**0,0**	2,50	**0,0**	0,215	**0,0**

Energy generation Reference: Projected building footprint area	Final energy		PER		PE		CO_2	
	Final energy generation	Final energy generation	PER factor	PER specific value	PE factor	PE Value	Emission factor (CO_2-eq)	CO_2eq emissions
	kWh/a	kWh/(m²$A_{Projected}$*a)	kWh/kWh	kWh/(m²$A_{Projected}$a)	kWh/kWh	kWh/(m²a)	kg/kWh	kg/a
				0,0		**0,0**		**0,0**
PV electricity	0	0,0	1,00	0,0	-		-	
Solar thermal system	0	0,0	-	0,0	1,20	0,0		
User determined energy carrier	0	0,0	1,00	0,0	2,50	0,0	0,530	0,0

PE demand requirement in case of verification through PE (non-renewable) [kWh/(m²a)]	-	Current building reaches following class	40	Requirement met?	-

Achievable energy standard through the verification of renewable primary energy (assessment of individual aspects)	Useful energy, performance				Airtightness
	Annual heat. dem.	Heating load	Useful cool. energy	Cooling load	n_{50}
	Treated floor area kWh/(m²a)	Treated floor area W/m²	Treated floor area kWh/(m²a)	Treated floor area W/m²	1/h
Requirement Passive House Premium					
Requirement Passive House Plus	15	10	17	10	0,60
Requirement Passive House Classic					
Requirement PHI Low Energy Building	30		32		1,00
Current building reaches following class for aspec	24	15	4	6	0,6
	PHI Low Energy Building		Premium		Premium



Summary Though, from the scientific point of view, not entirely correct, different energy carriers will be added together here. This is done to meet the criteria of other energy standards.	Final energy	PER specific value	PE value	CO2eq emissions	CO_2eq substitution balance
	MWh/a	MWh/a	8-PE factors user determined MWh/a	2-CO2 factors user determined kg/a	2-CO2 factors user determined kg/a
Demand	**105,5**	**116,8**	81,57	17292	17292
Generation	**0,0**	**0,0**	0,00	0	0
Demand, cumulative generation (annual balance)	105,49	116,76	81,57	17292	17292
Demand w/o household electricity	**96,0**	**104,4**	57,80	12254	12254
Demand w/o household electricity, cum. generation	95,98	104,41	57,80	12254	12254

Heat pump

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

			Building type:	Športna dvorana	
			Treated floor area A_{TFA}:	2043	m²
Covered fraction of space heating demand			*('PER' worksheet)*	0%	
Space heating demand + distribution losses		Q_H+Q_{HL}:	*(DHW+Distribution)*	51466	kWh/a
Solar fraction for space heat		$\eta_{Solar,\ H}$	*('SolarDHW' worksheet)*	0%	
Effective annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$			**0**	kWh/a
Covered fraction of DHW demand			*('PER' worksheet)*	35%	
Total heating demand of DHW system		Q_{gDHW}	*(DHW+Distribution)*	28050	kWh/a
Solar fraction for DHW		$\eta_{Solar,\ DHW}$	*('SolarDHW' worksheet)*	0%	
Effective DHW demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$			**9817**	kWh/a
Number of heat pumps in the system				1	
Functionality				DHW	
Heating					
Selection of HP: 1-Toplotna črpalka zrak/voda		Heat source:		1-Outdoor air	
Selection of distribution system				3-Supply air heating	
Design distribution temperature		θ_{design}	*(DHW+Distribution)*	55,00	°C
Nominal power of distribution system		P_{nom}		70,00	kW
Distribution system (to be completed by experienced users only)					
Nominal power of distribution system		P_{nom}		70,00	kW
Radiator exponent		n			
Heat storage tank (buffer storage tank 'DHW+Distribution' worksheet)				0-No	
Specific heat losses storage		U * A $_{Storage}$			W/K
Storage location in thermal envelope				1-Inside	
Room temperature (storage location: outside of thermal envelope)			*(DHW+Distribution)*		°C
Sink temperature of heat pump for heating		θ_{snk}		55,00	°C
Entries in relation to the domestic hot water system					
Selection of HP: 1-Toplotna črpalka zrak/voda		Heat source:		1-Outdoor air	
DHW temperature			*(DHW+Distribution)*	60,00	°C
Orientation of DHW storage tank ('storage 1' in 'DHW+Distribution' worksheet)				1-Inside	
Specific heat losses storage		U * A $_{Storage}$		3,0	W/K
Room temperature (storage location: outside of thermal envelope)			*(DHW+Distribution)*	20,00	°C
Type of backup heater				1-Elec. Immersion heater	
Δθ of electric continuous flow water heater					K
Additional options in case of <u>one</u> heat pump for both functions: Heating & DHW					
Same heat pump's sink temperature for Heating and for DHW				1-Yes	
Heat pump priority			*(Manufacturer, tech. data)*	2-Heating priority	
Control strategy					
Heat pump control strategy				2-Ideal	
Heating					
Depth ground water / Ground collector / Ground probe		z			m
Power of pump for ground heat exchanger		P_{pump}			kW

District heating and combined heat power (CHP)

Šolski center Slovenj Gradec - telovadnica / Climate: Ljubljana T1996-2005/J1981-2000 / TFA: 2043 m² / Heating: 24,5 kWh/(m²a) / Cooling: 3,7 kWh/(m²a) / PER: 57,2 kWh/(m²a)

		Building type:	Športna dvorana	
		Treated floor area A_{TFA}:	2043	m²
Covered fraction of space heating demand	*('PER' worksheet)*		100%	
Annual heating demand kWh/a	Q_H *(DHW+Distribution)*		51466	kWh
Solar contribution for space heating	$\eta_{Solar,\ H}$ *('SolarDHW' worksheet)*		0%	
Effective annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		**51466**	kWh
Covered fraction of DHW demand	*('PER' worksheet)*		65%	
DHW demand	Q_{DHW} *(DHW+Distribution)*		27314	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *('SolarDHW' worksheet)*		0%	
Effective DHW demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		**17754**	kWh

		PE factor (non-renewable)	CO_2 emissions factor (CO_2-eq)
		kWh_{PE}/kWh_{Final}	kg/kWh
Definition of heat source for PE factor and CO_2 emissions	21-Gas CHP (small) 35% CHP	0,00	0,000

Definition of heat source for calculation of PER factor

Heat net

Efficiency district heating net: 95%

CHP complex & boiler for peak loads	Fraction	Efficiency Electricity	Efficiency Heat		PER factors	PER factors
CHP complex	90%	30%	65%	**Within biomass budget**	1,10	0,85
Boiler for peak loads	10%		96%	**Excess of biomass budget**	1,85	1,43
Total	100%			**DHW Summer**	1,30	1,00

Performance ratio of heat transfer station	$h_{a,HX}$	105%	
Utilisation factor of heat transfer station	$\eta_{a,SHX}$	95%	
		kWh/a	kWh/(m²a)
Final energy demand heat generation	Q_{final} = Q_{Use}* $e_{a,DH}$	72863	35,7
Annual PE demand (non-renewable primary energy)		0	0,0
		kg/a	kg/(m²a)
Annual CO_2-equivalent emissions		0	0,0