Add On Skills - 2022
Final Presentation

Białystok University of Technology

Faculty of Civil Engineering and Environmental Sciences

Academic year 2021/2022

TEAM 03

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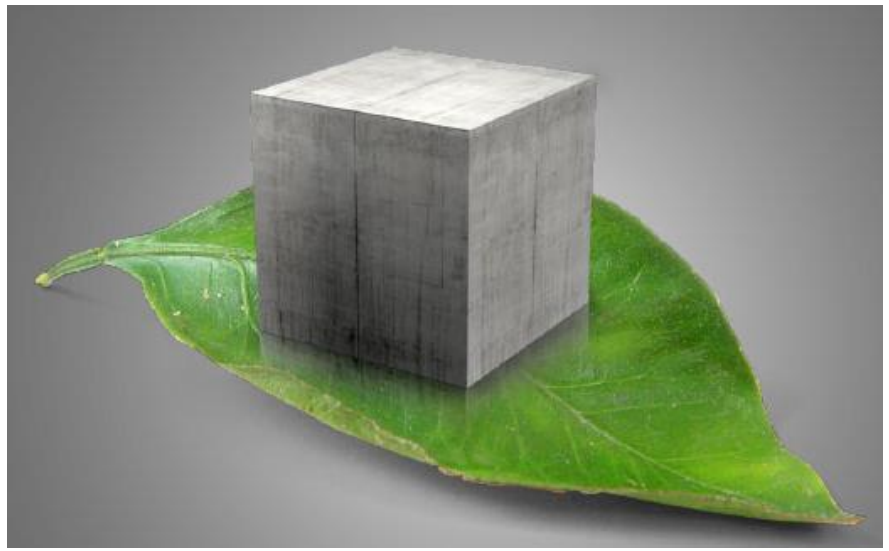
Best use of technology

- **BUT**
- Renewable energy
- HVAC design
- UNIFI
- UCO
- VTDK
- RTA



Renewable Energy

Solar collector lab

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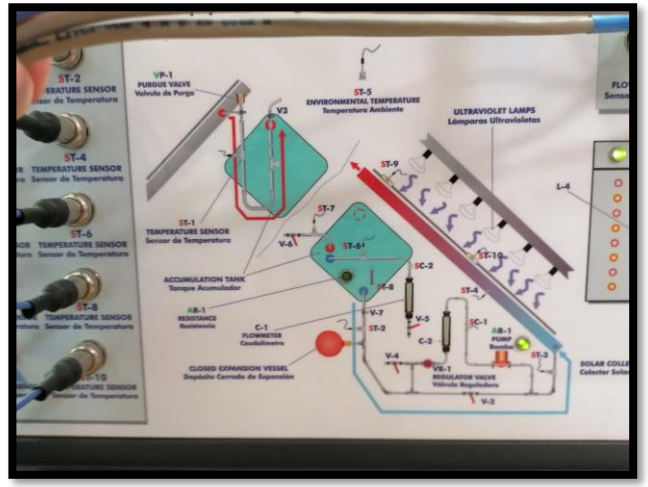

The instantaneous efficiency of the solar collector is the ratio of the useful energy to the energy of solar radiation. The instantaneous efficiency of the solar collector can be determined at a given moment from the ratio of the useful power Q_u to the solar radiation power:

$$\eta = \frac{Q_u}{I \cdot A} \cdot 100\% = \frac{m \cdot c \cdot \Delta T}{I \cdot A} \cdot 100\%$$

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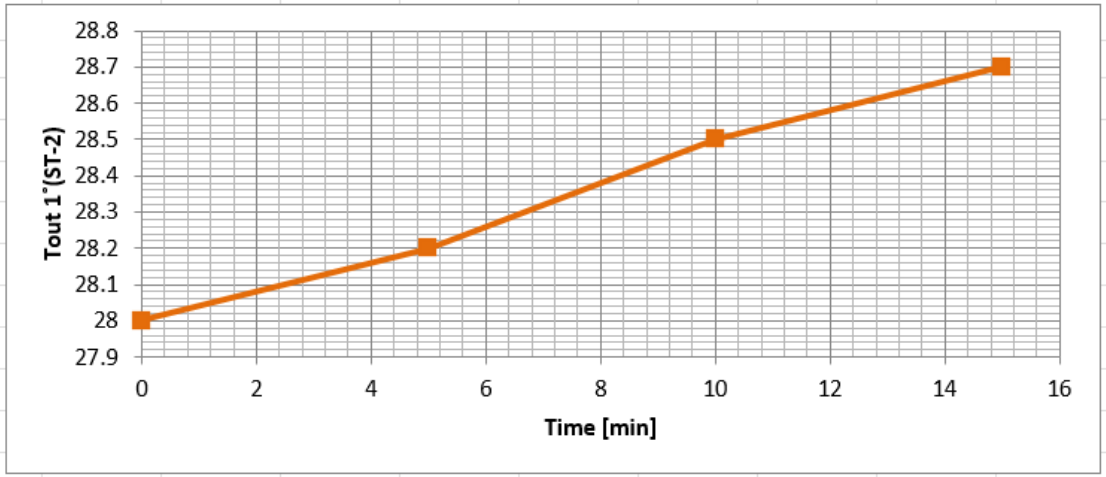
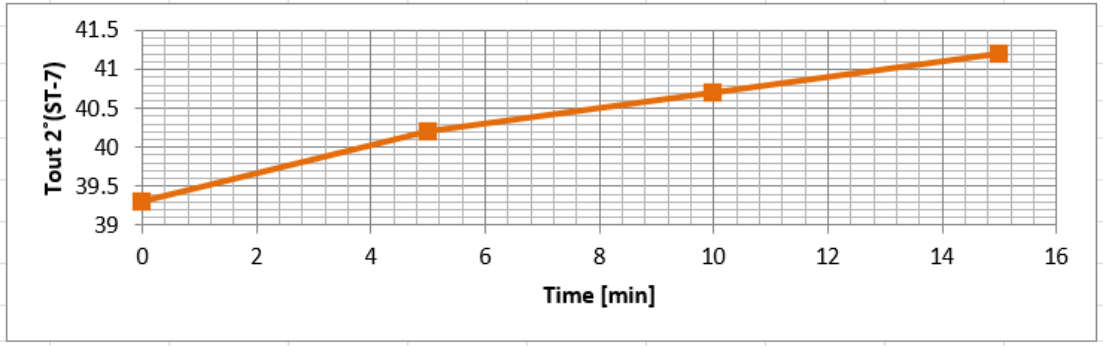
Temperature [°C]	Time [min]			
	0	5	10	15
$T_{out\ 1}$ (ST-1)	51	51.5	51.9	52.2
$T_{in\ 1}$ (ST-2)	28	28.2	28.5	28.7
$(T_{in}+T_{out})/2$	39.5	39.85	40.2	40.45
T_a (ST-5)	23	23	23	23
$(T_{in1}+T_{out1})/2-T_a$	16.50	16.85	17.20	17.45
ρ [kg/m^3]	992.6	992.5	992.4	992.3
Q_I [l/h] (SC-1)	40	40	40	40
m [kg/s] (SC-1)	0.011	0.011	0.011	0.011
c_p [J/kg/K]	4180	4180	4180	4180
Qu [W]	1060.34	1074.04	1078.51	1083.02
A [m2]	2.13	2.13	2.13	2.13
E [W/m2]	600	600	600	600
η [%]	82.97	84.04	84.39	84.74
$T_{in\ 2}$ (ST-6)	25	25.2	25.4	25.7
$T_{out\ 2}$ (ST-7)	39.3	40.2	40.7	41.2
$T_{collect}$ (ST-4)	47.1	47.4	47.8	48.1
Q_{II} [l/min] (SC-2)				

Average efficiency: 83.80 %





Renewable Energy

Wind turbines

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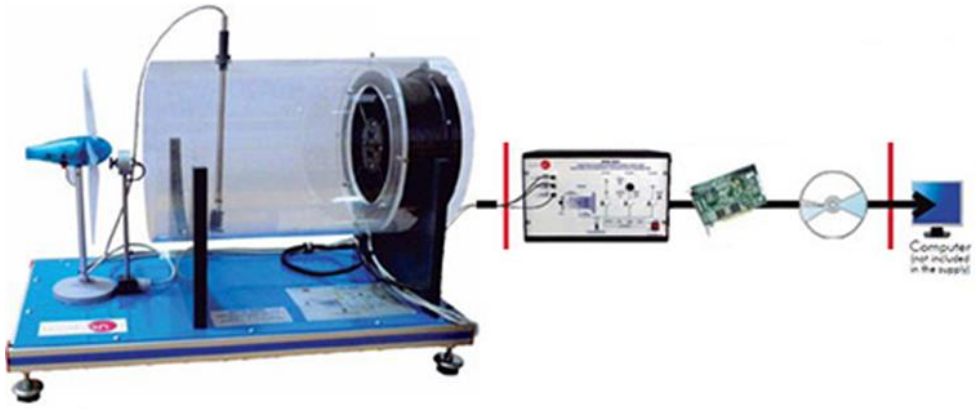
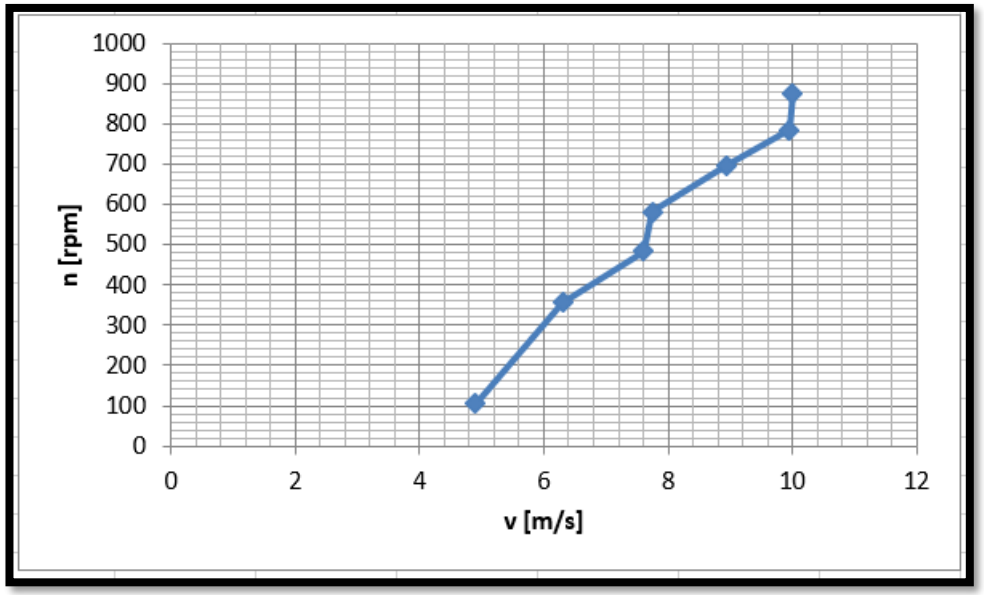
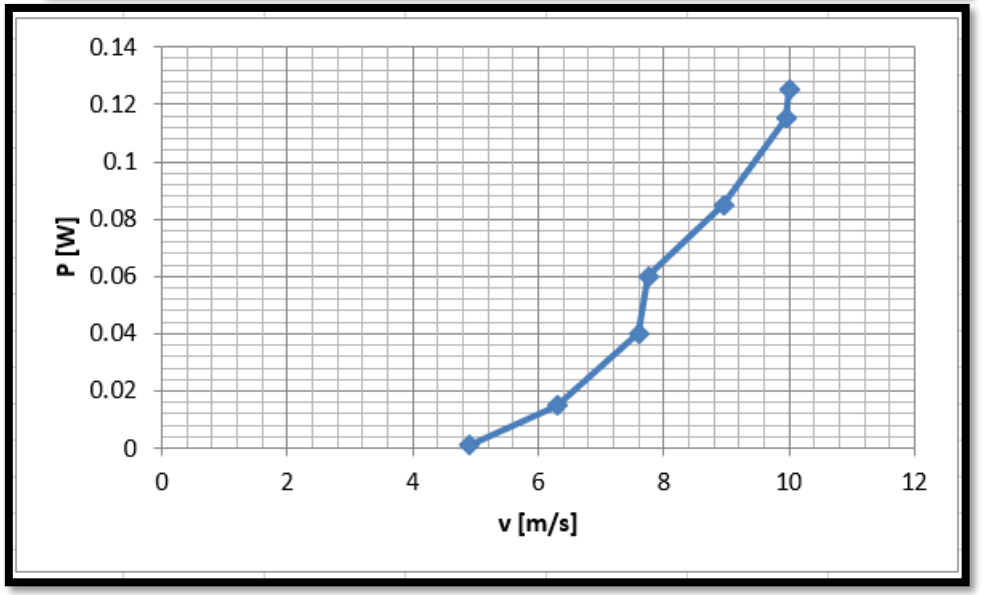


Setting						
$n\%_{MAX}$	v	v_{avg}	n	n_{avg}	P	P_{avg}
%	m/s	m/s	rpm	rpm	W	W
40	5	4.9	108	105	0.001	0.001
	4.8		102		0.001	
50	6	6.3	350	355	0.01	0.015
	6.6		360		0.02	
60	7.2	7.6	469	483.5	0.03	0.04
	8		498		0.05	
70	7	7.75	570	580	0.05	0.06
	8.5		590		0.07	
80	8.5	8.95	681	697	0.07	0.085
	9.4		713		0.1	
90	9.9	9.95	777	783.5	0.1	0.115
	10		790		0.13	
100	9.8	10	857	876	0.12	0.125
	10.2		895		0.13	





HVAC design

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Name of proj.:	Design of floor heating system
Address:	Via Celestino Bianchi, 10
City:	Firenze
Designer:	Andrea Menci
Date of calc:	Monday 4 July 2022 16:54

Info on pipes type:

Type A:	KAN BLUEFLOOR	Type B:	
Type C:		Type D:	
Type E:		Type F:	
Type G:		Type H:	
Type I:		Type J:	
Type K:		Type L:	
Type M:		Type N:	
Type O:		Type P:	

Symbol of the heat source:	HANGING BOILER

Parameters of the heating agent:

θ_s, [°C]:	50,00	θ_r, [°C]:	40,00
$\theta_{r,r}$, [°C]:	33,67		
Type of agent:	Water	Concentration, [%]:	100,0

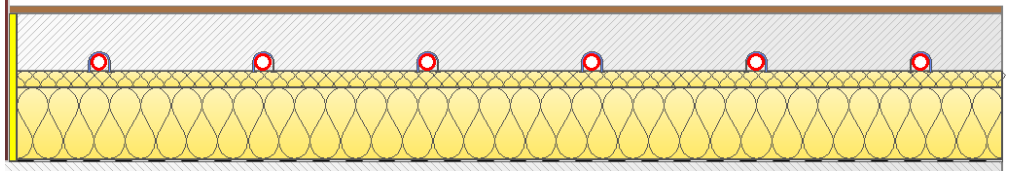
Info on the heating system:

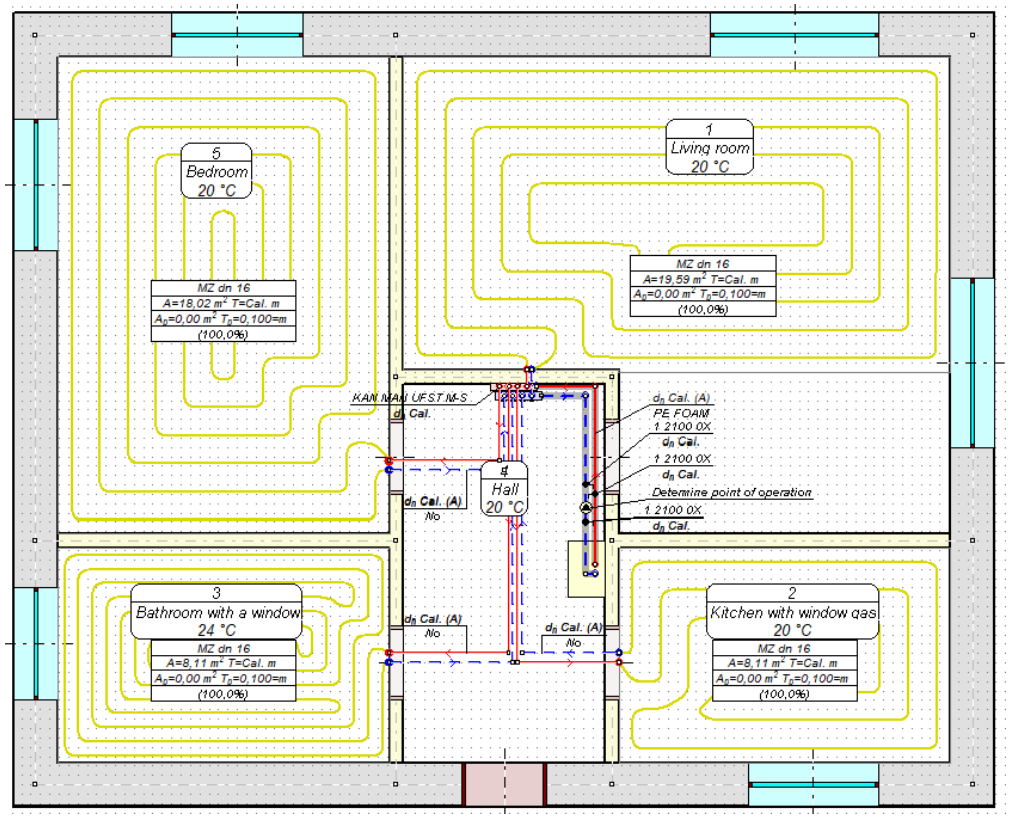
The total water flow in the installation M_{inst}, [kg/s]:	0,066
Total installation capacity V_{inst}, [l]:	32
Calculation thermal power of the installation $\Phi_{HL,inst}$, [W]:	2863
Power lost $\Phi_{lost,inst}$, [W]:	897
Total power transferred by the installation $\Phi_{tot,inst}$, [W]:	3760

Parameters of the heat source: HANGING BOILER

Δp_{HS}, [Pa]:	1000	V_{HS}, [l]:	5,0
Required disposable pressure in the source Δp_{disp}, [Pa]:			8084
Additional power reserve for charging the buffer $\Phi_{HL,reserve}$, [W]			
The total design power of the heat source in winter $\Phi_{HL,winter}$, []:			2863
culated thermal power of the source in the summer $\Phi_{HL,summer}$, [W]:			
design power of the heat source in transition period $\Phi_{HL,part}$, []:			
Number of concurrently working flat stations. $N_{FS,sim}$, [pcs.]:			

Info on the material	d	λ	ρ	R
	m	W/(m·K)	kg/m³	m²·K/W
Floor covering: Linoleum 0.015 m²·K/W				0,015
Cement screed.	0,0700	1,300	2200	0,054
KAN-therm Tacker foamed polystyrene board EPS100 038 (PS20)	0,0200	0,038	20	0,526
Profil2 foamed polystyrene board EPS100 038 (PS20) whit PS f	0,0900	0,038	20	2,368
PE foil for laying under thermal insulation D = 0,15 mm	0,0002	0,200	1300	0,001
Concrete base under the floor.	0,1500	1,400	2200	0,107





Design of a school in Bialystok

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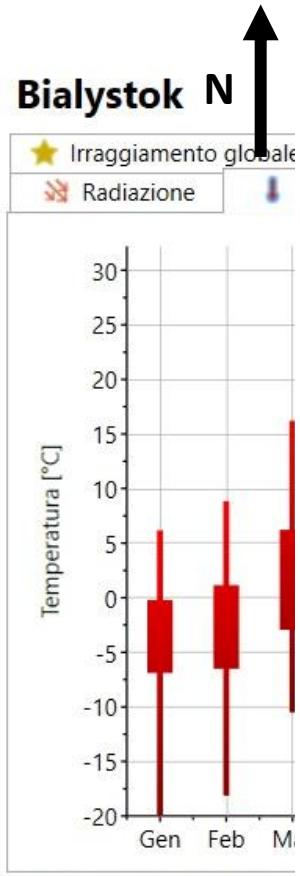

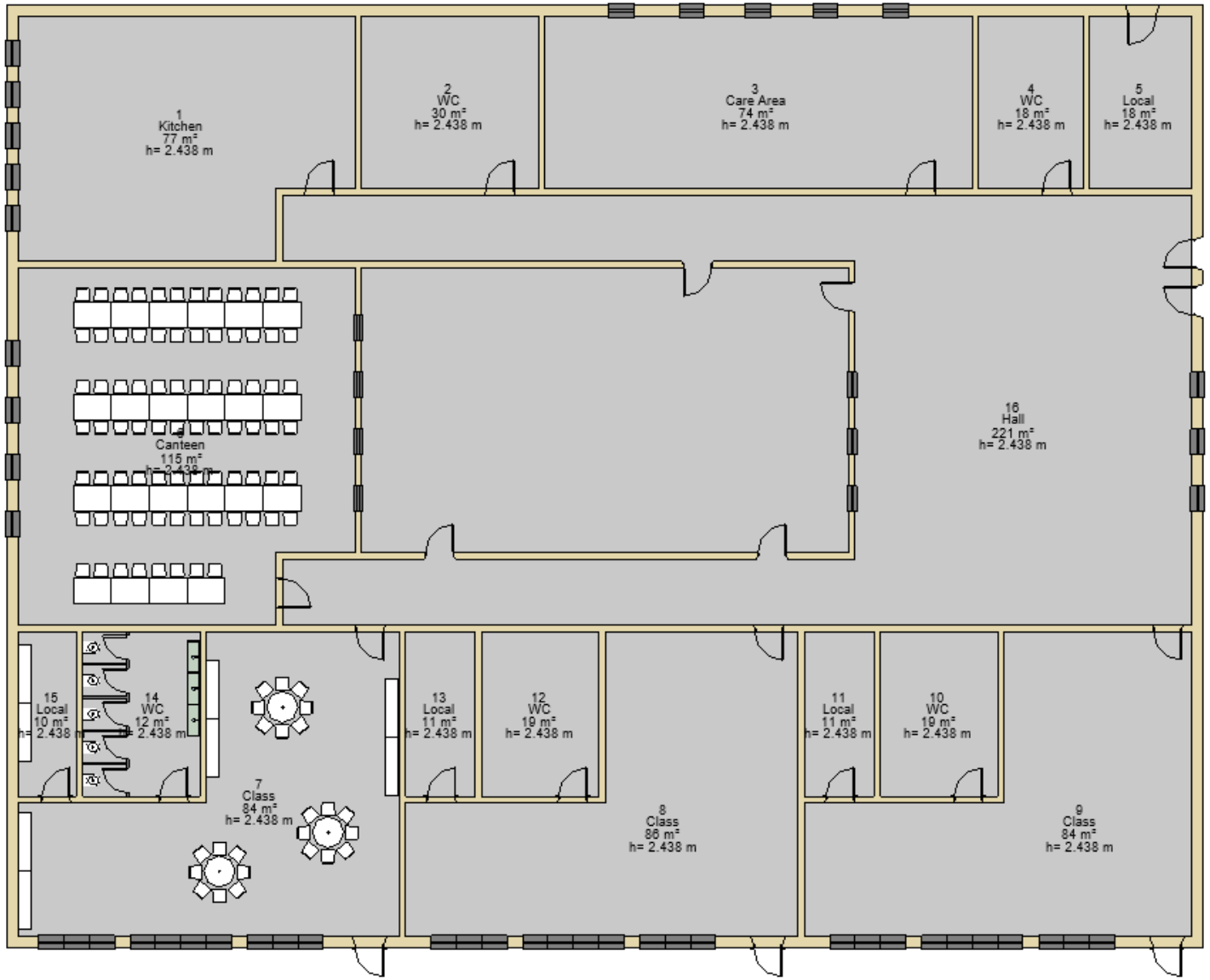

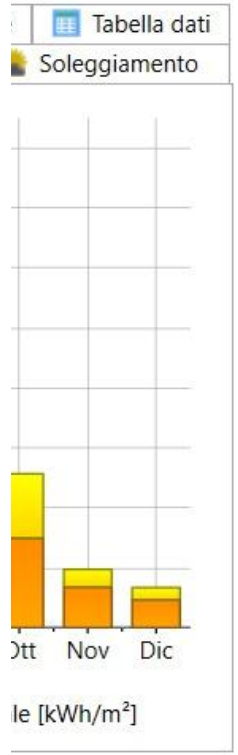

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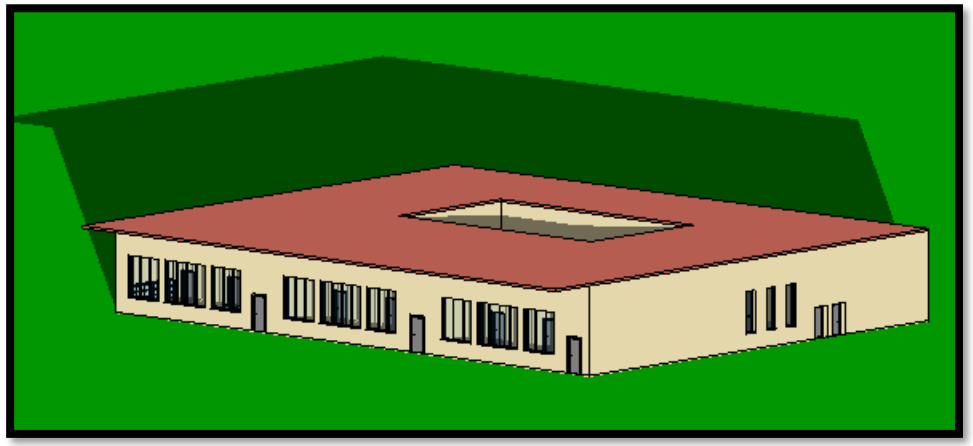
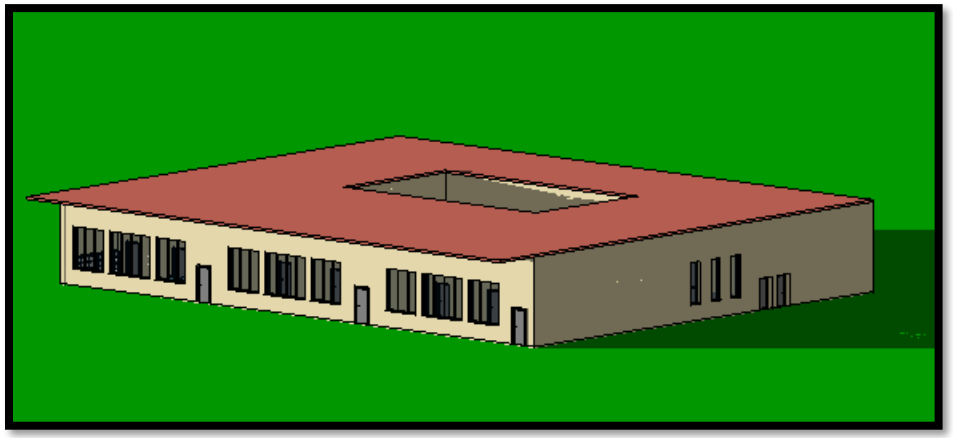
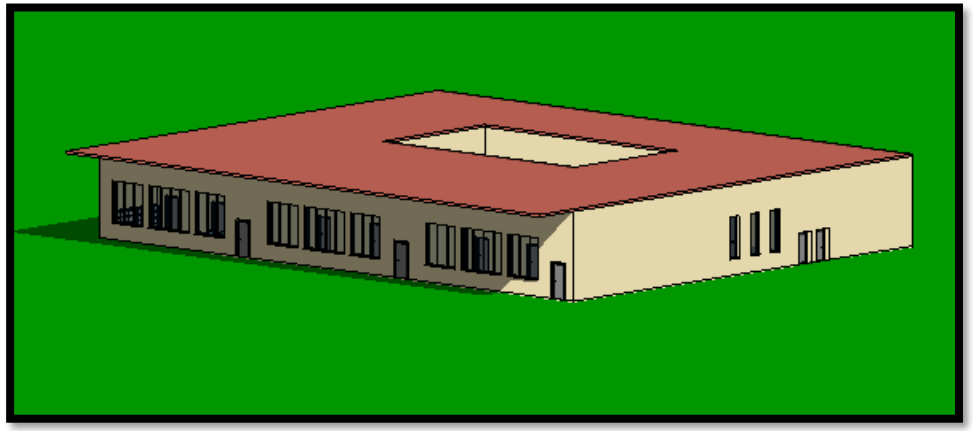


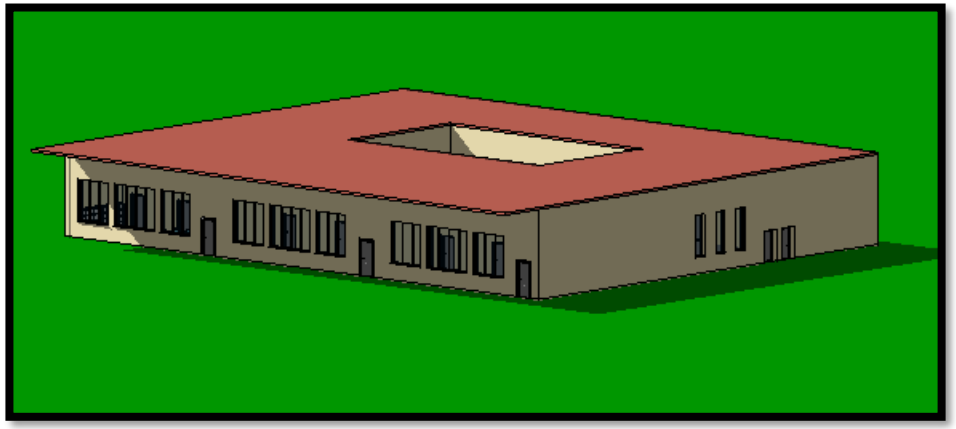
21 December 9:00



21 December 16:00



21 June 9:00



21 June 16:00

Erasmus+ add-on-skills

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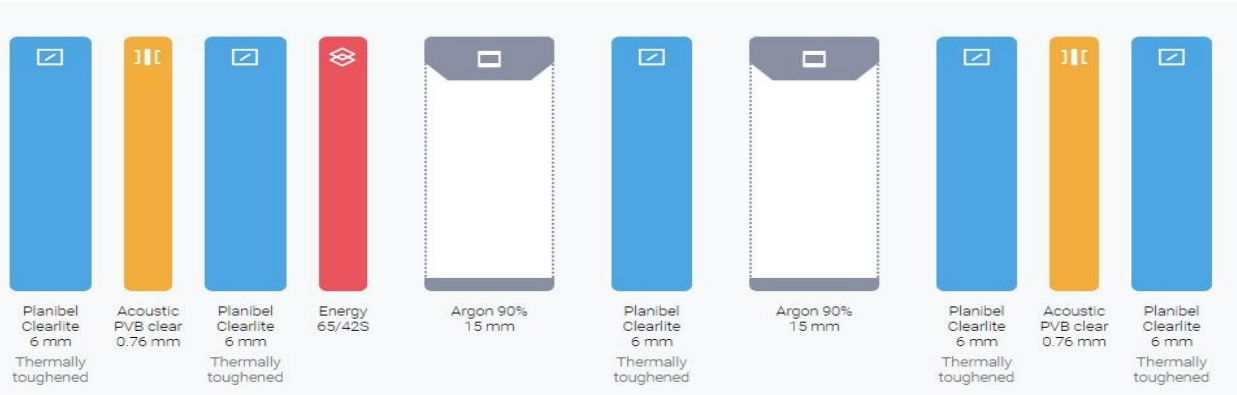

Performance summary

55	35	28	26	0.40	0.8
LT	SF	LR	LRint	SC	Ug

1) Type of building elements — **Chiusura verticale**

2) Scegliere il periodo delle variazioni termiche (<= 24 ore) 24

Periodo delle variazioni termiche T	[sec]	86400
Resistenza termica sup interna Rsi	[m2K/W]	0.13
Resistenza termica sup esterna Rse	[m2K/W]	0.04

	Air	Layer descripton	Thickness (s) [m]	Thermal conductivity (λ) [W/mK]	Thermal resistance [mqK/W]	Calore specifico (c) [J/kgK]	Density (ρ) [kg/m3]	Air thermal resistance [m2K/W]	Profondità di penetrazione al periodo T	ξ = s/d	Thermal Resistance [m2k/w]
Rsi	Air	Internal layer		1	2	3	4	5			0.130
1	☐	Plasterboard panel	0.022	0.230	0.090		800				0.090
2	☐	Air Cavity	0.070	0.000	0.000		12				0.000
3	☐	Rock wool	0.040	0.040	1.143		100				1.143
4	☐	OSB panel	0.025	0.130	0.102		640				0.102
5	☐	Water and windproof sheet	0.002	0.030	0.053		40				0.053
6	☐	Insulation layer	0.120	0.040	3.420		30				3.420
7	☐	OSB panel	0.025	0.130	0.102		640				0.102
8	☐	External insulation	0.020	0.040	0.500		30		#DIV/0!	#DIV/0!	0.500
9	☐	External plaster	0.040	1.100	0.027		13		#DIV/0!	#DIV/0!	0.027
Rse	☐	External layer									0.040

Total thickness of the stratigraphy [cm] **36.40**

Total thermal resistance [m2K/W] **5.607**

http://www.mygreenbuildings.org — **RESULTS** — 2011 @ Ing. Andrea Ursini Casalena

Regime periodico stabilizzato T = 24 ore

Decremen factor	fd	[-]	#RIF!
Time shift	φ	[h]	#RIF!
Periodic thermal transmittance	|Yie|	[W/m2K]	#RIF!

Regime stazionario

Surface mass	Ms	[kg/m2]	59
Resistenza termica totale	Rt	[m2K/W]	5.607
Thermal transmittance	U	[W/m2K]	0.178

Green Roof

BUT

Renewable energy

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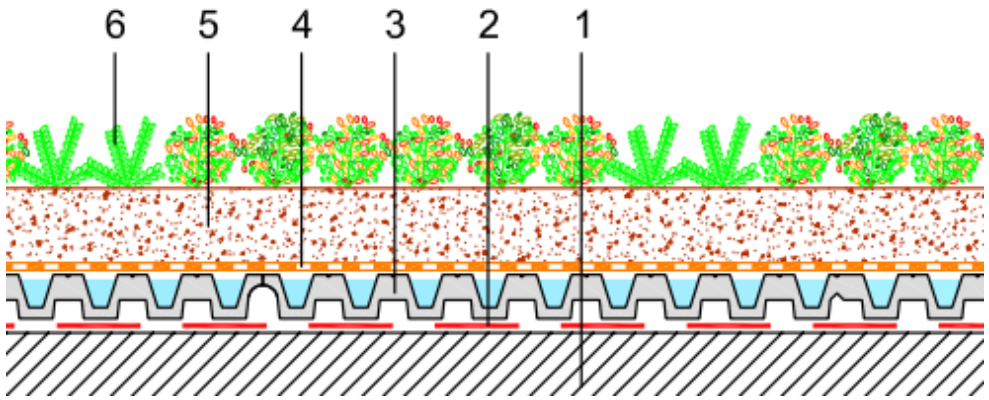
In Poland temperatures range from -22°C to +30°C. Part of the roof is shaded all day.

We therefore choose to use an EXTENSIVE GREEN ROOF, which needs little water, little maintenance and the plants can survive even without the sun.

This kind of roof is less expensive than intensive green roof.

Layer of extensitive green roof:
1- Sloping floor (with insulation layer);
2- Rootproof waterproof covering (mechanical protection layer) – 4 mm
3- Draining and storage element in EPS (storage capacity 5l/m2) – 47 mm
4- Protective filter element (geotextile sheet) – 2 mm
5- Soil layer consisting of volcanic aggregates – 80 mm
6- Vegetal layer composed of sedum
Total weight → 93,00 km/m2



Design of Photovoltaic panels

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1. WORKING CONDITIONS

	Daily Solar Radiation in collector (Kwh/m^2)	Sun peak hour (HSP)
January	0,61	0,61
February	1,25	1,25
Mach	2,61	2,61
April	3,90	3,90
May	5,23	5,23
June	5,32	5,32
July	5,35	5,35
August	4,55	4,55
September	3,00	3,00
October	1,61	1,61
November	0,67	0,67
December	0,55	0,55
Annual		34,66

2. ELECTRC LOADS

Corrected Electric Load (Wh/day)

19 740,93

	Percentage of occupance
January	90
February	100
Mach	100
April	80
May	100
June	100
July	10
August	80
September	100
October	100
November	100
December	10

3. DETERMINATIONN OF THE FACTOR Y= L/HSP

2 961,14

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4. CHARACTERISTICS OF THE PV PANELS

Panel Power (W)	300
Panel Voltage (V)	24

Working Voltage (V)	24
Intensity in the Maximun power point (A)	8
Voltage in the Maximum Power Point (V)	36
Short Circuit Intensity (A)	9
Open Circuit Voltage (V)	46

5. DESIGN OF THE PV SYSTEM

Number or PV Panel in Serie		1.00
Number of PV Panel in Parallel		109.00
TOTAL NUMBER OF PV PANELS	109.00	
Total Power of the PV system (W)	32,700.00	

6. CHARACTERISTIC OF THE BATTERIES

Volatage of the Batteries (V):	12
Battery Capacity (Ah):	250
Depth of discharge (%):	75,00%
Wire losses (%):	100,00%

7. DESIGN OF THE BATTERY BANK

Number of autonomy days:	10
Capacity of the Battery Bank (Ah):	10 967,18
Number of Batteries in Serie in the Proyect:	2,00
Number of Batteries in Parallel in the Proyect:	44,00

8. DESING OF CHARGE CONTROLLER SYSTEM

Intensity of the selected Charge Controller (A):	60,00
NUMBER OF CHARGE CONTROLLER OF THE PROYECT:	2,00

9. DESIGN OF THE INVERTER

Power of the selected inverter (W):	1 200,00
NUMBER OF INVERTERS OF THE PROJECT:	4,00

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Design Solar collectors

1. WORKING CONDITIONS

	Daily Solar Radiation in collector (Kwh/m^2)	Ambient temperature (ºC)	Temperature of network water (ºC)	Number of Days by month	Monthly Solar Radiation in collector (Kwh/m^2)
January	0,61	-3,30	6,33	31	19,00
February	1,25	-2,20	5,51	28	35,00
Mach	2,61	1,80	6,07	31	81,00
April	3,90	8,30	7,91	30	117,00
May	5,23	13,80	10,57	31	162,00
June	5,32	17,20	13,31	30	159,68
July	5,35	19,50	15,40	31	166,00
August	4,55	18,70	16,28	31	141,00
September	3,00	13,80	15,70	30	90,00
October	1,61	8,10	13,82	31	50,00
November	0,67	3,60	11,15	30	20,00
December	0,55	-0,60	8,42	31	17,00
Annual			35		1 058

2. WATER DEMAND AND HEATING LOAD

Occupance: (Nº Persons)	75,00
Percentage of Occupance (%)	100,00
Water Demand/person(60ºC)	3,00
Storage temperature (ºC)	60,00

Monthly water demand	Heating Load (MJ/month)	Heating Load (Kwh)
66 128	13 638	3 788

3. COLLECTOR SPECIFICATIONS

Collector Area (m^2)	2,00
Optical efficiency Fr($\tau\alpha$)	0,95
Heat Loss Coefficient Fr U_L	3,67
Height (m)	2,10
Inclination	15,50
Orientation	45,00

	Absorbed energy/m^2 (Kwh/m^2)	Thermal losses/m^2 (Kwh/m^2)	Useful Energy/m^2 (Kwh/m^2)	Collector efficiecy (%)
Annual	1 006,91	84,25	922,65	87,23

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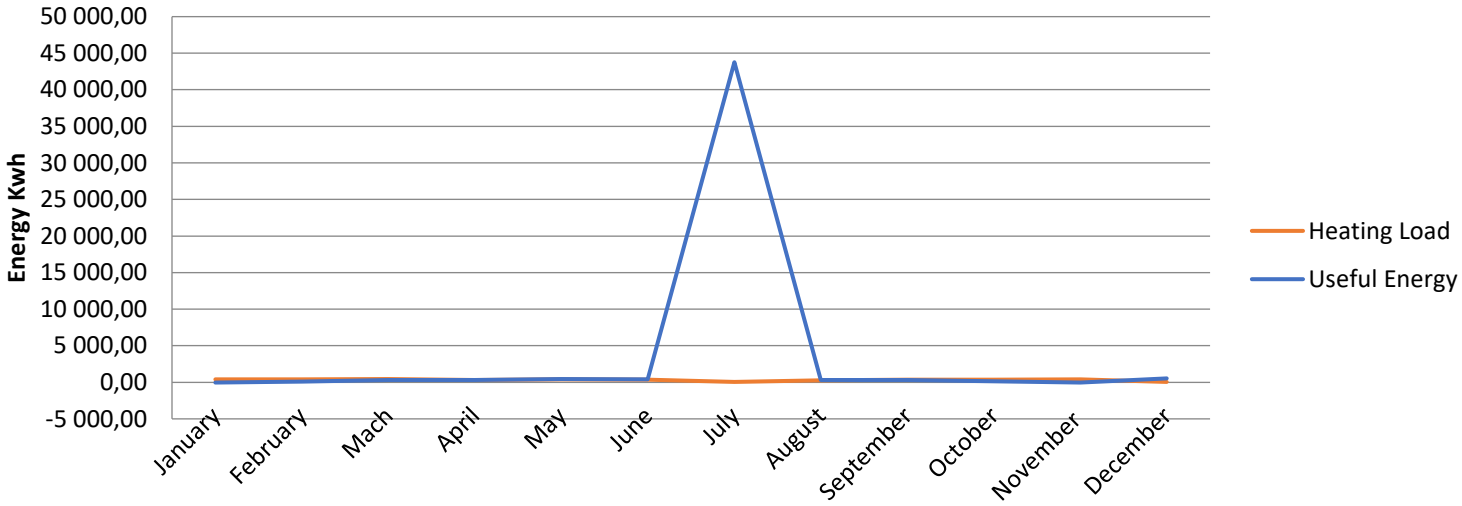
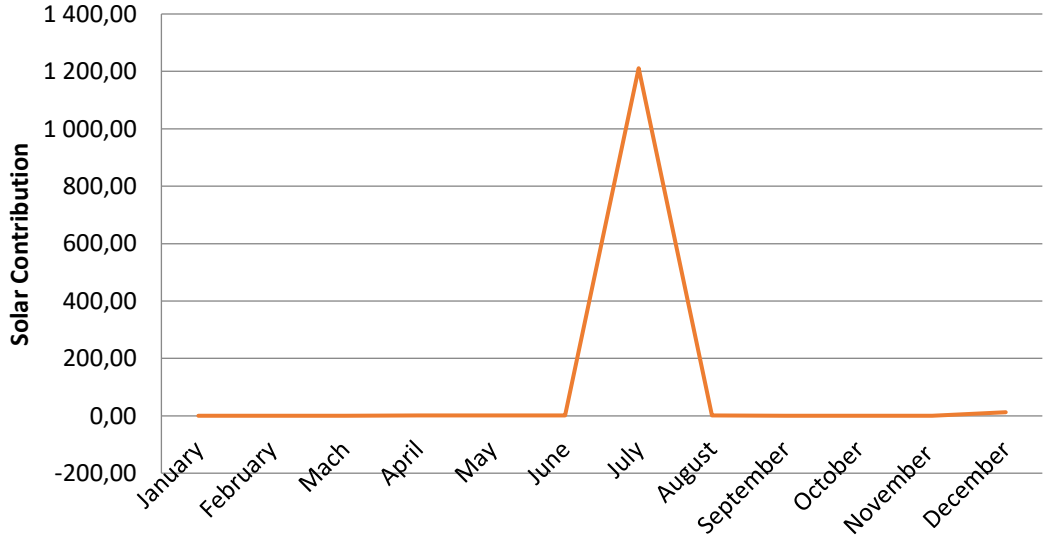
4. DESIGN OF INSTALLATION (f-chart method)

Proposed total collector area (m2)	10,00
Proposed number of Collectors	5
Proposed volume of tank (l):	200,00





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BIM

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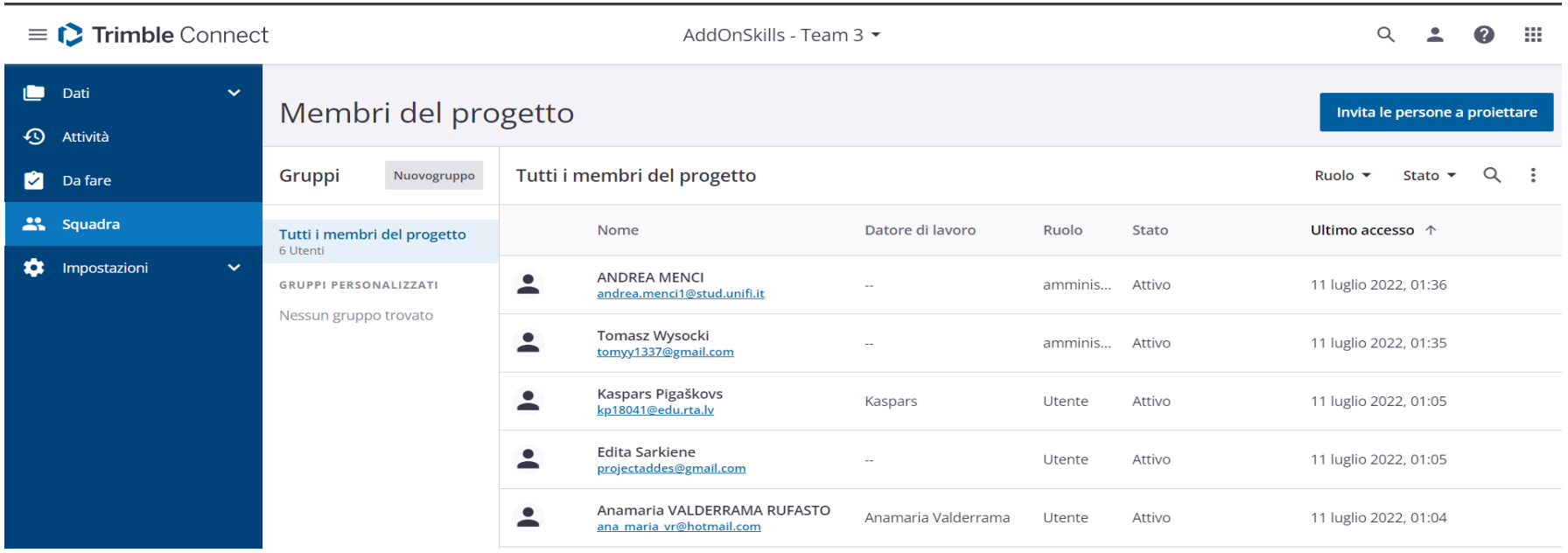

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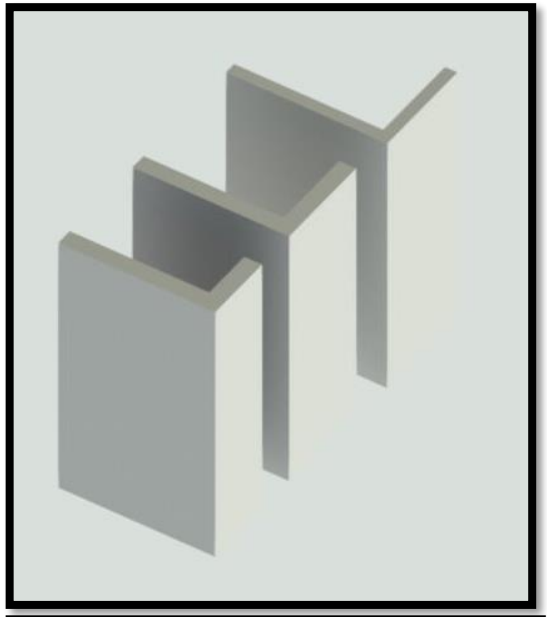

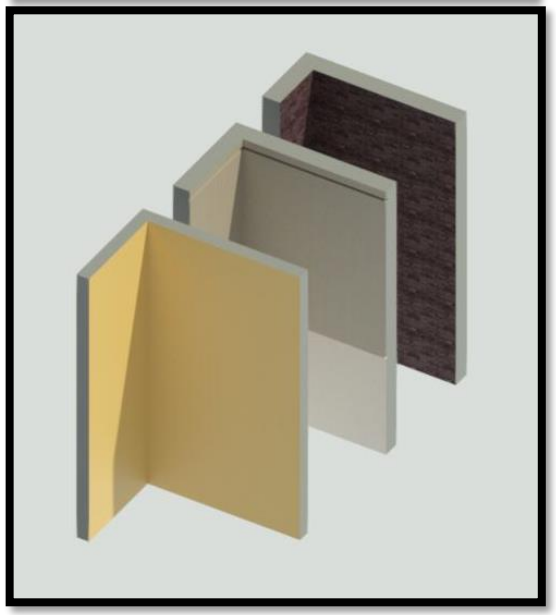

Type Properties

Family: System Family: Basic Wall — Load...

Type: 1 — Duplicate...

Rename...

Type Parameters

Parameter	Value
Construction	
Structure	Edit...
Wrapping at Inserts	Do not wrap
Wrapping at Ends	None
Width	514.0
Function	Exterior
Graphics	
Coarse Scale Fill Pattern	
Coarse Scale Fill Color	Black
Materials and Finishes	
Structural Material	Concrete Masonry Units
Analytical Properties	
Heat Transfer Coefficient (U)	0.1902 W/(m²·K)
Thermal Resistance (R)	5.2568 (m²·K)/W
Thermal Mass	48.81 kJ/K
Absorptance	0.700000
Roughness	3
Identity Data	

What do these properties do?

<< Preview — OK — Cancel — Apply

IoT

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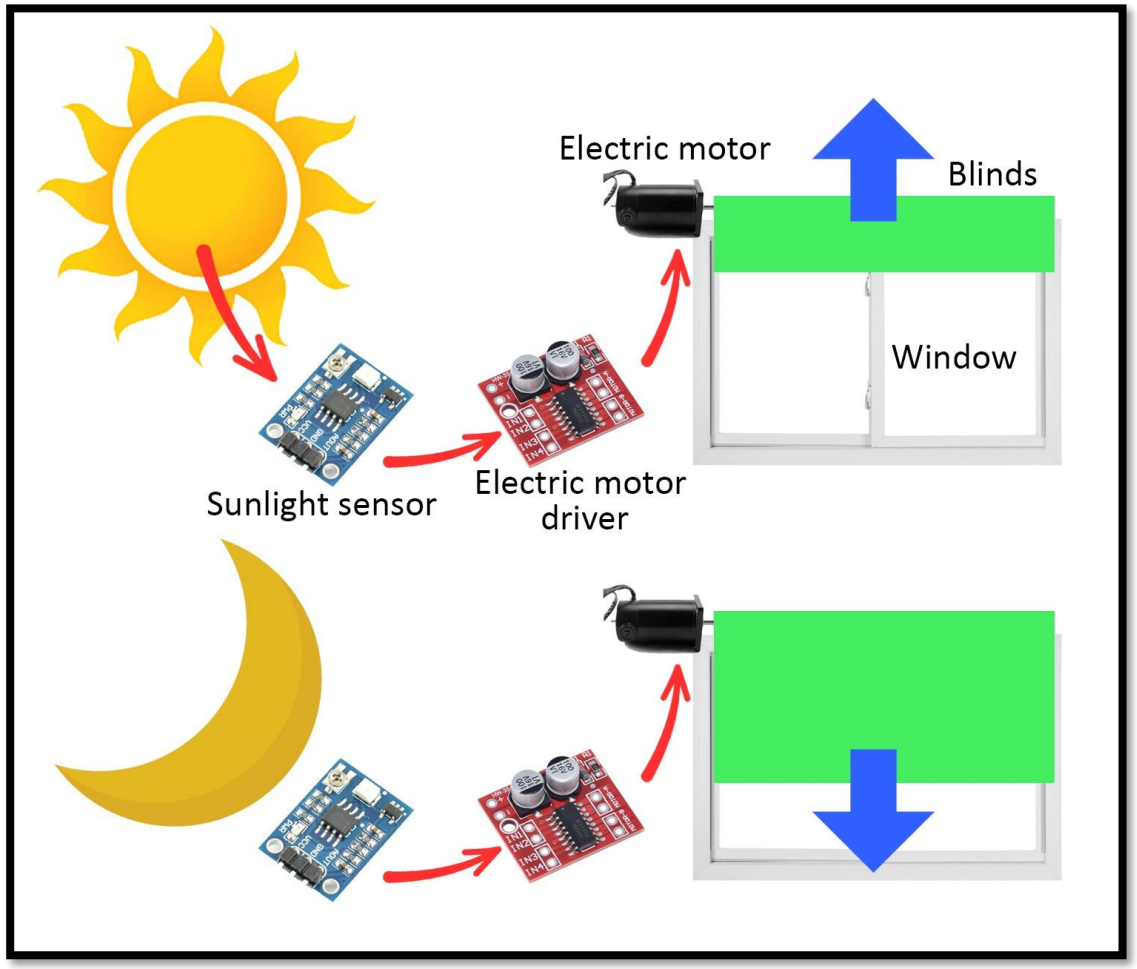
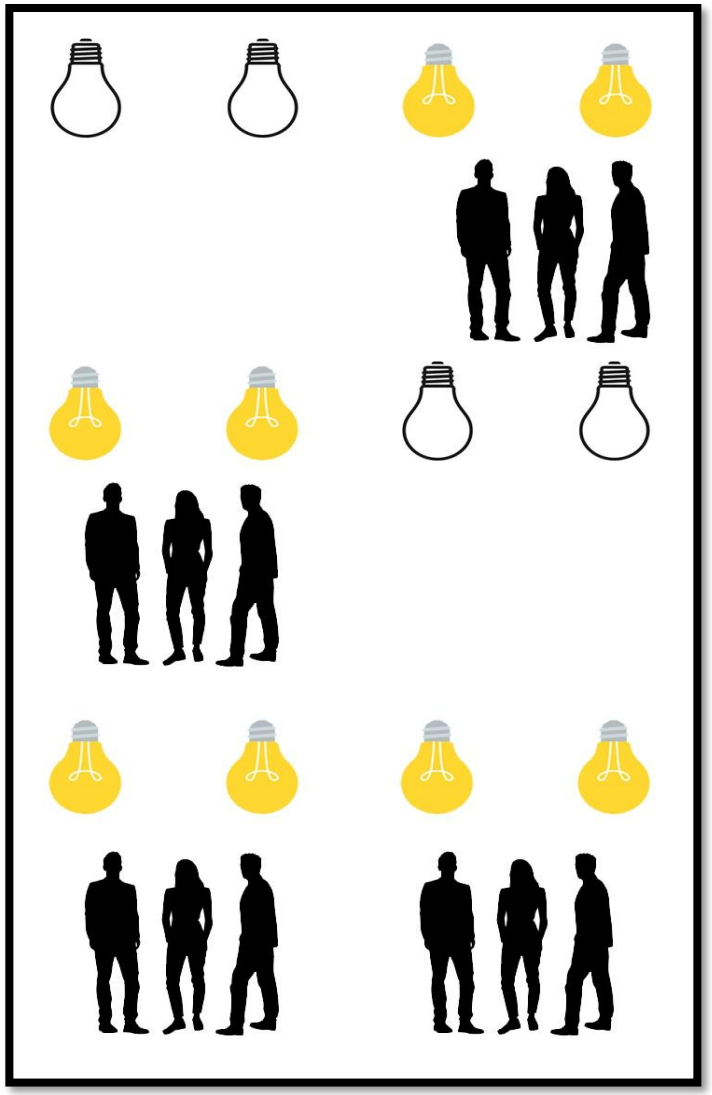
- VTDK
- **RTA**



Automatic tents

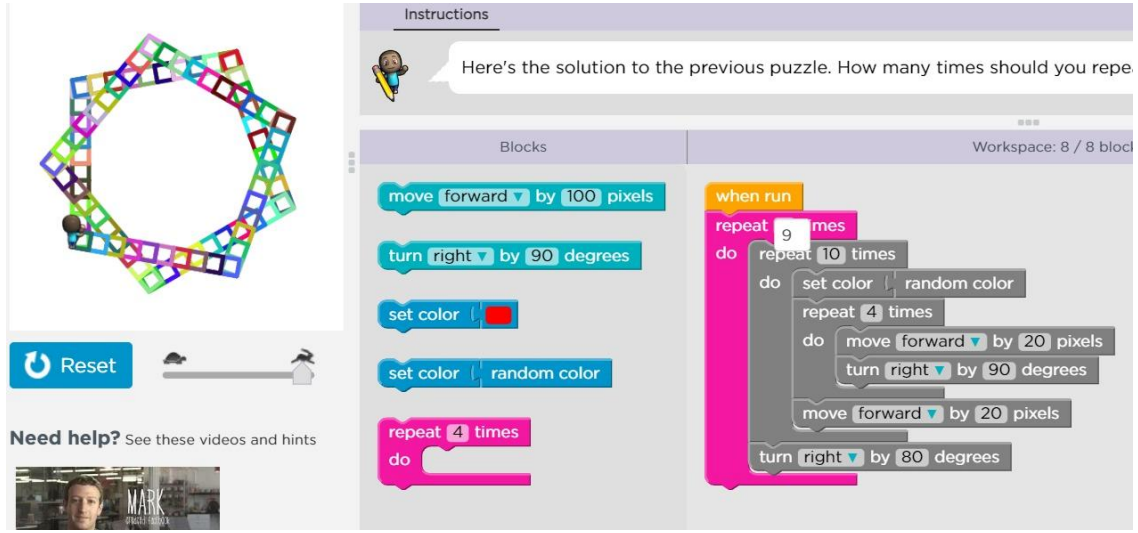


Automatic lights

IoT

Erasmus+ add-on-skills

- BUT
- Renewable energy
- HVAC design
- UNIFI
- UCO
- VTDK
- **RTA**



IoT

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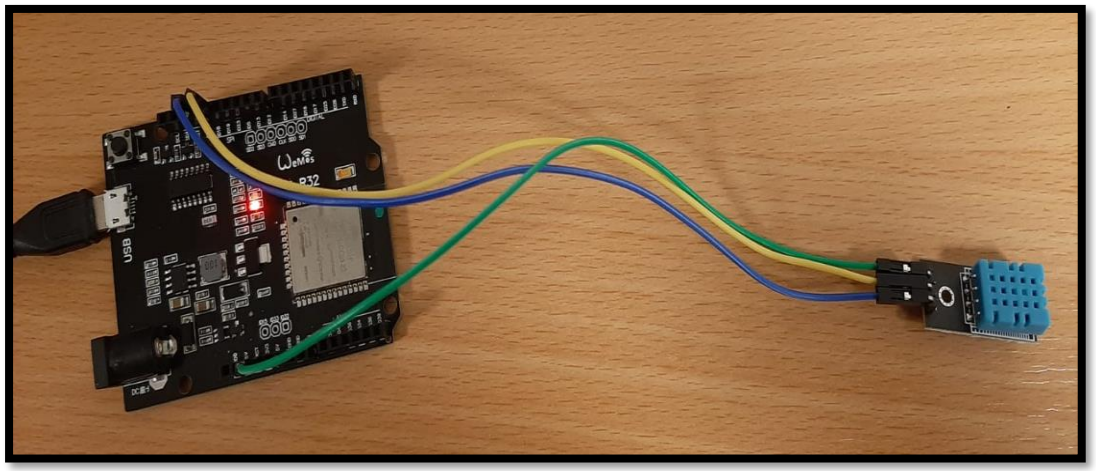

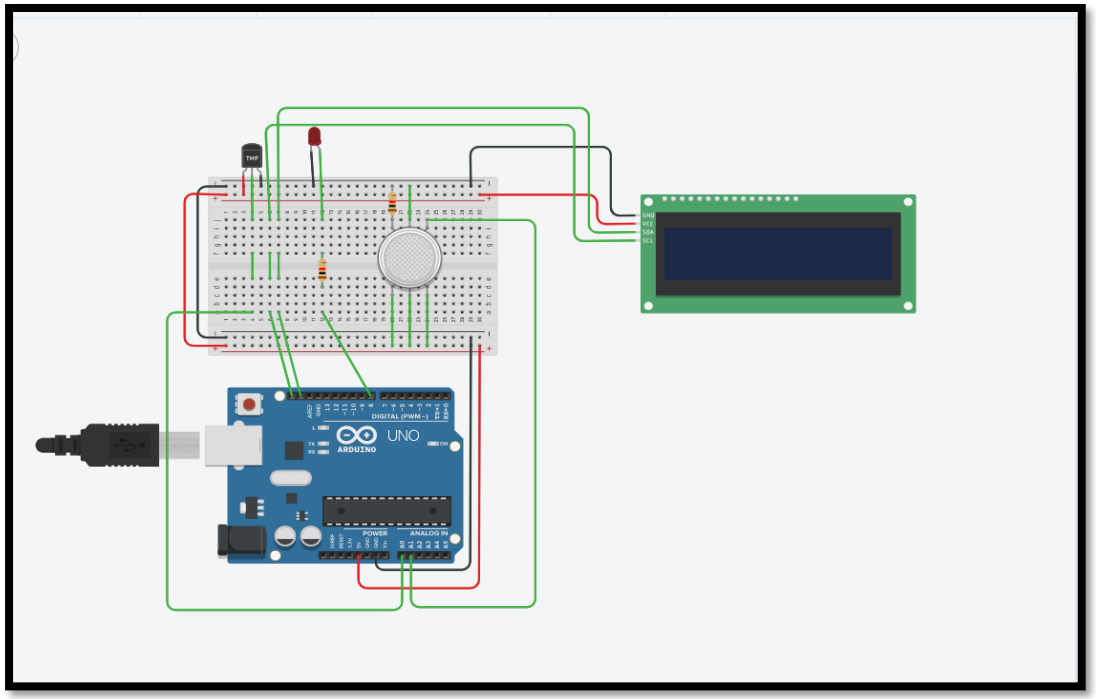

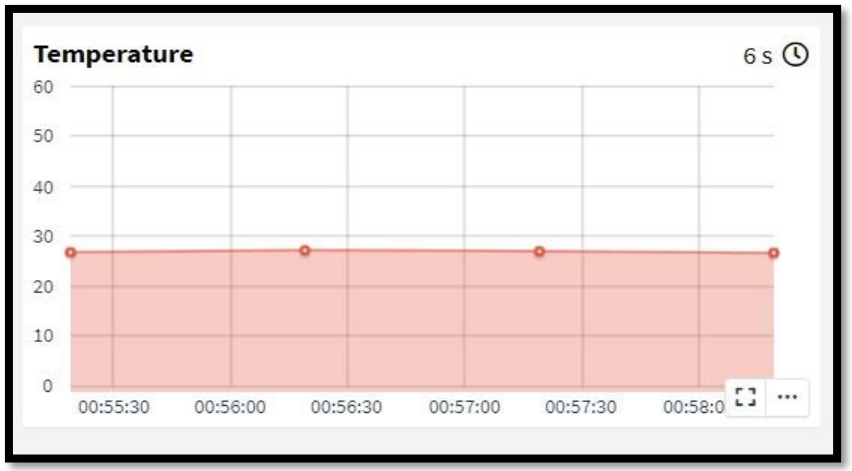

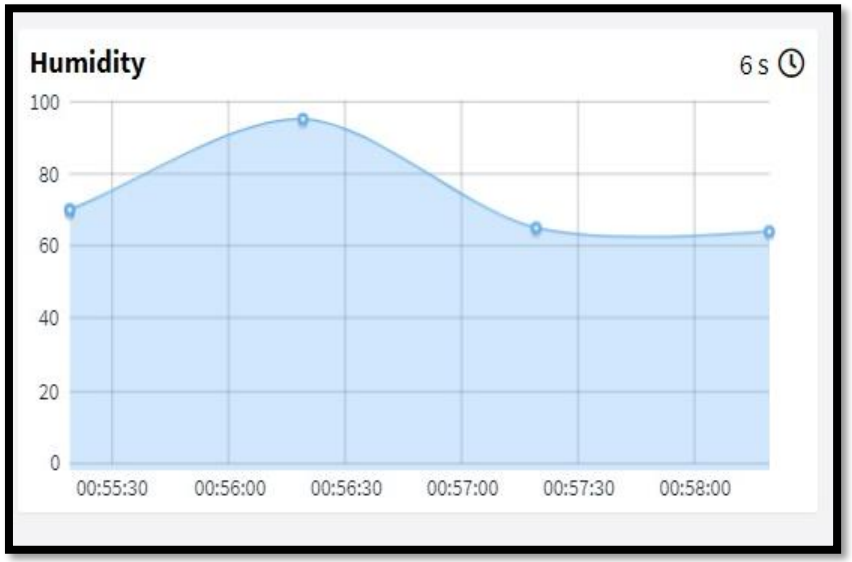

THANKS FOR YOUR ATTENTION

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