PARAMETRI LOKACIJE I ENERGETSKA EFIKASNOST U ZGRADARSTVU

LOCATION PARAMETERS AND ENERGY EFFICIENCY IN BUILDINGS

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1. Introduction

Location parameters are often neglected during design, and they can sometimes affect the final energy class of buildings.

Location parameters are all parameters that can affect the final energy consumption of buildings.

All the location parameters can be sorted into two groups: natural and created.

The natural location parameters are: Sun, wind, water, vegetation and terrain configuration.

The created location parameters are: the position, shape and orientation of the building, as well as their distance from each other.

1. Introduction

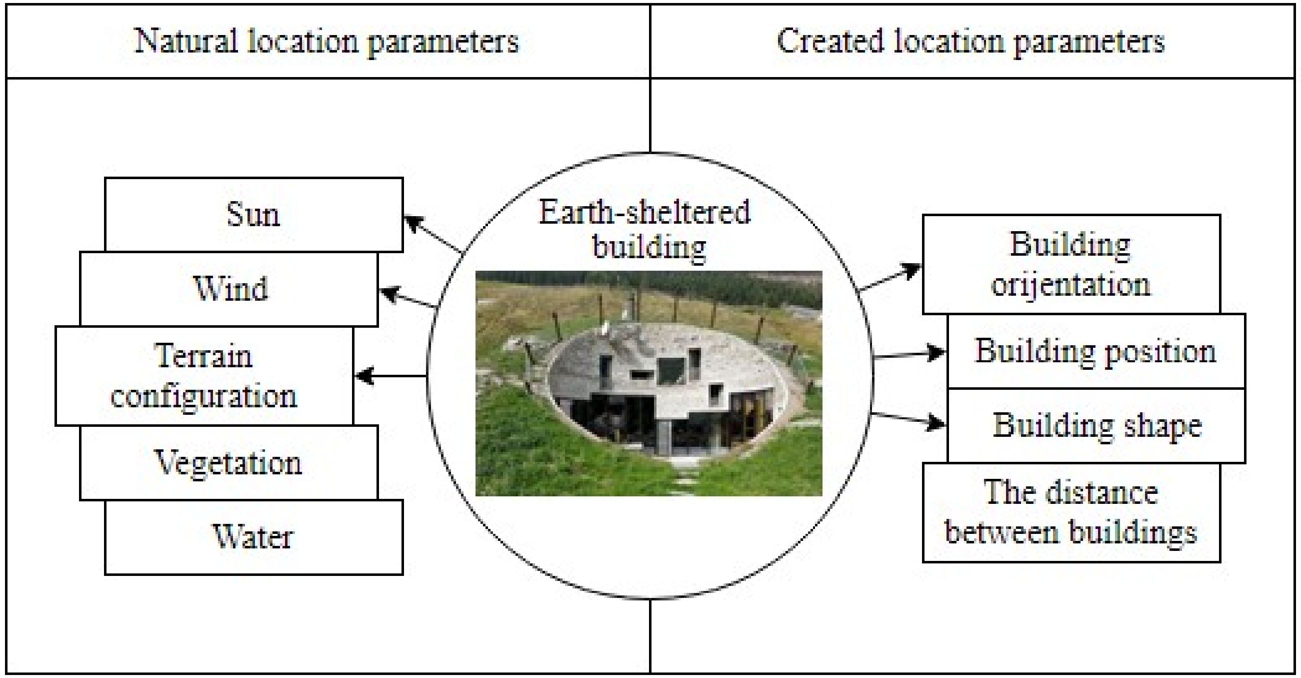


Figure 1. Earth-sheltered building and location parameters

Figure 2. Small leaved lime

The aim of this paper is to reduce the final energy consumption on a concrete building located in Kragujevac, by applying natural and created location parameters.

2. Research subject

2.1 Building model

The net area: 102.5 m^2
The net conditioned area: 98.5 m^2
The total surface of the thermal shell: 337.6 m^2
Window-wall ratio is 9.92%
The shape factor of the building is 1.27

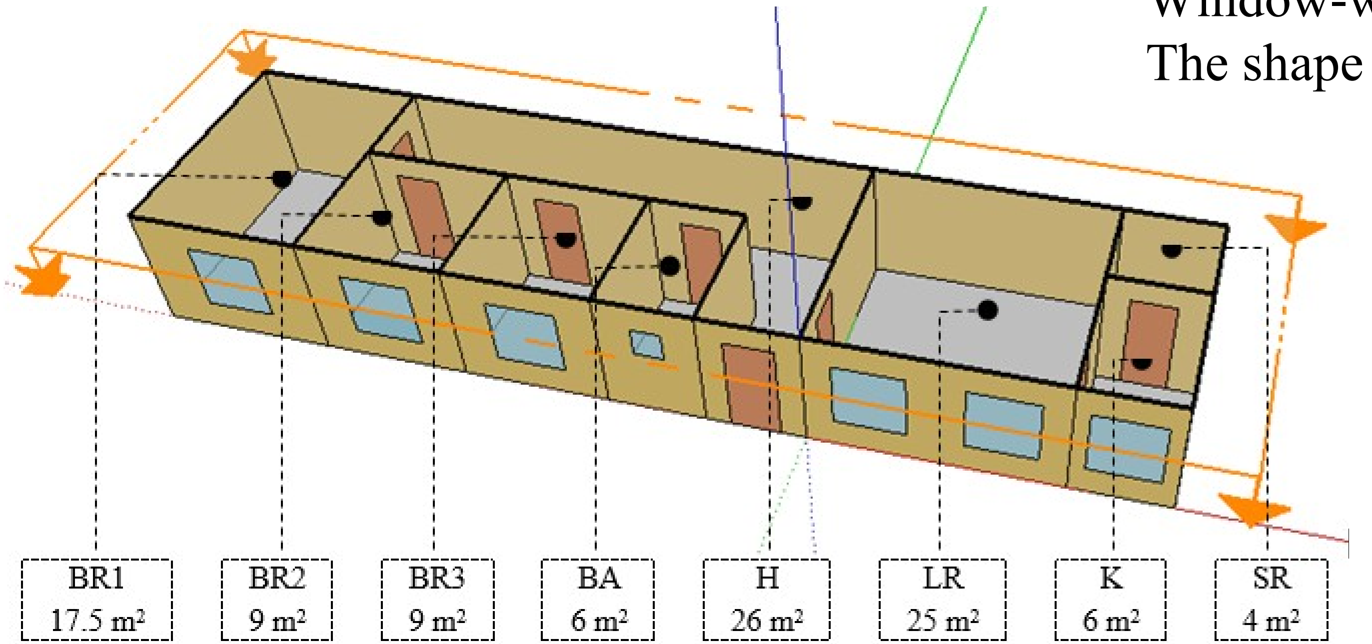


Figure 3. Isometric view and room arrangement

BR1 – badroom 1; BR2 – badroom 2; BR3 – badroom 3; BA – bathroom; H – hall; LR – living room; K – kitchen; SR – storage room

2. Research subject

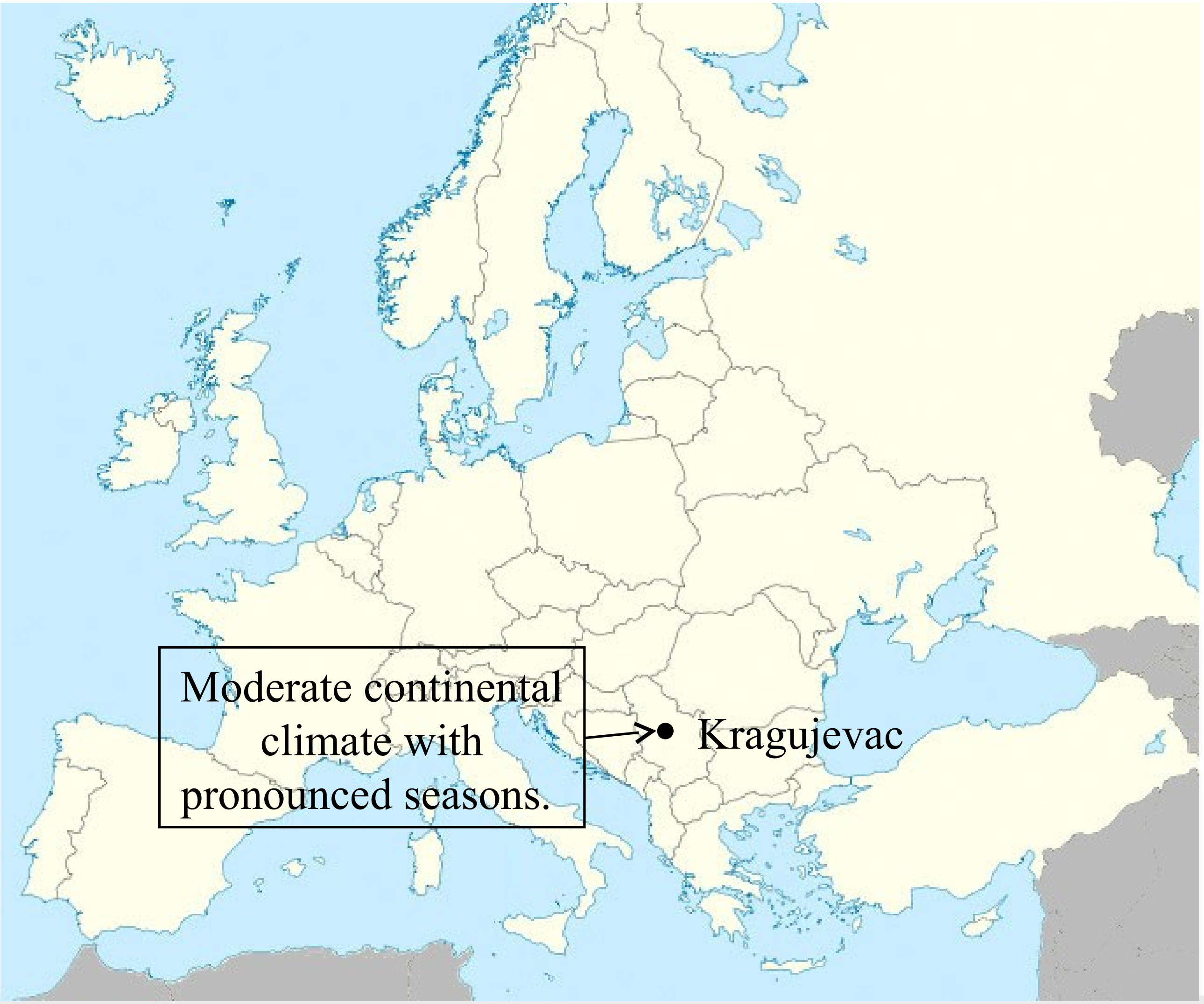
2.1 Building model

Table 1. Serbian building energy performance regulation

Parameter	Description	Building model	New buildings
Heat transfer coefficient [W/m²K]	Exterior wall	0.269	0.3
	Flat roof (above heated room)	0.148	0.15
	Flat roof (above unheated room)	0.148	0.3
	Floor	0.249	
	Window	1.5	
	Exterior door	1.012	1.6
Heating set-point [°C]	Bathroom	22	
	Other rooms	20	
Outdoor air flow rate [h^{-1}]	Kitchen	1.5	
	Bathroom		
	Other rooms	0.5	

2. Research subject

2.2 Building location



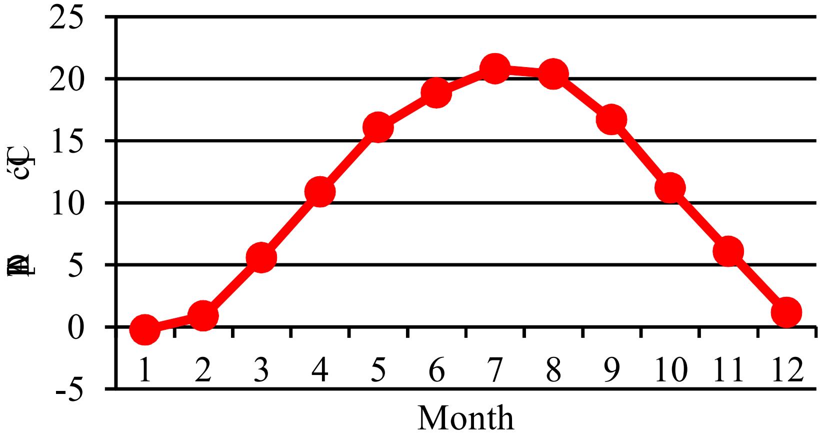


Figure 4. Air drybulb temperature

Kragujevac
Latitude: 44.02°N
Longitude: 20.92°E
The average altitude: 209 m
The time zone: GMT+1h

2. Research subject

2.3 Description of thermotechnical systems

Table 2. Technical parameters REHAU GEO 7 heat pumps and vertical geothermal probes

REHAO GEO 7		GVP	
Parameter	Value	Parameter	Value
$Q_{GSHP\text{-}COND}$ [W]	7300	n_B [-]	2
COP [-]	4.1	H_B [m]	73.2

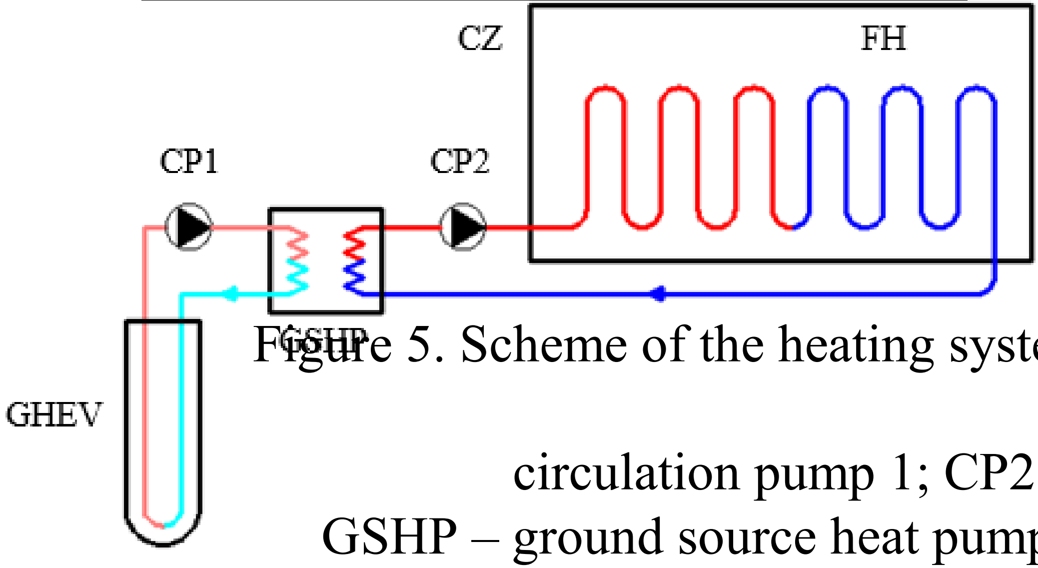


Figure 5. Scheme of the heating system

CP1 – circulation pump 1; CP2 – circulation pump 2; GSHP – ground source heat pump; GHEV – vertical ground heat exchanger; CZ – conditioned zones; FH – floor heating

Table 3. Technical parameters Window air conditioner Venting WFM1 12RNH1

Venting WFM1 12RNH1	
Parameter	Value
$Q_{WAC\text{-}COND}$ [W]	3.5
COP [-]	2.6
V_{WAC} [m^3/h]	460

3. Scenario simulation

Figure 6. Scenario simulation

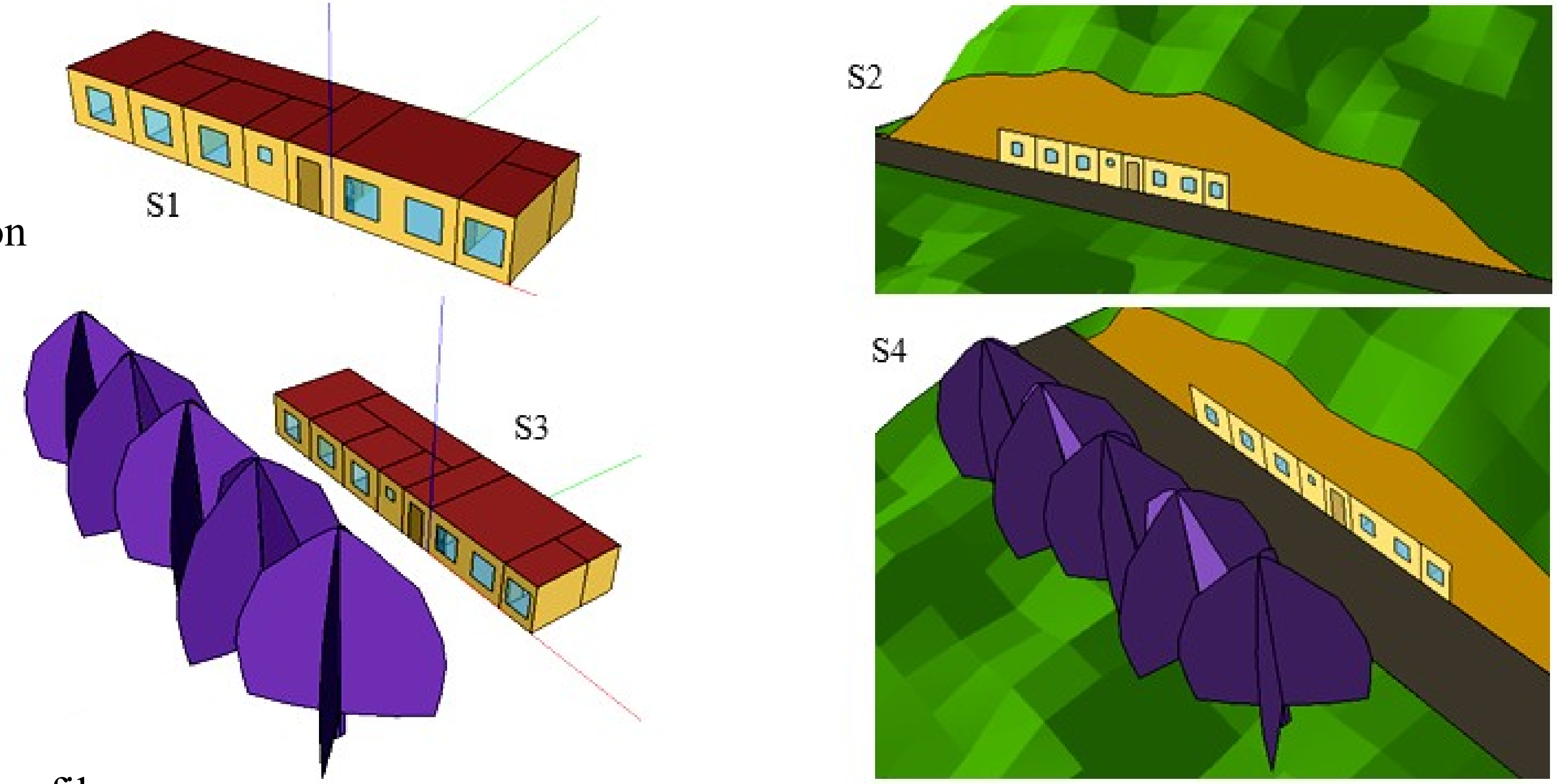


Table 2. Small leaved lime profile

Parameter	Distance from the south facade	Number of seedlings	Tree height	Trunk height	Crown diameter	Pillowing time	Leaf fall time
Description	10 m	5	10 m	7.1 m	7.46 m	15.04.-01.05.	15.10.-01.11.

4. Results

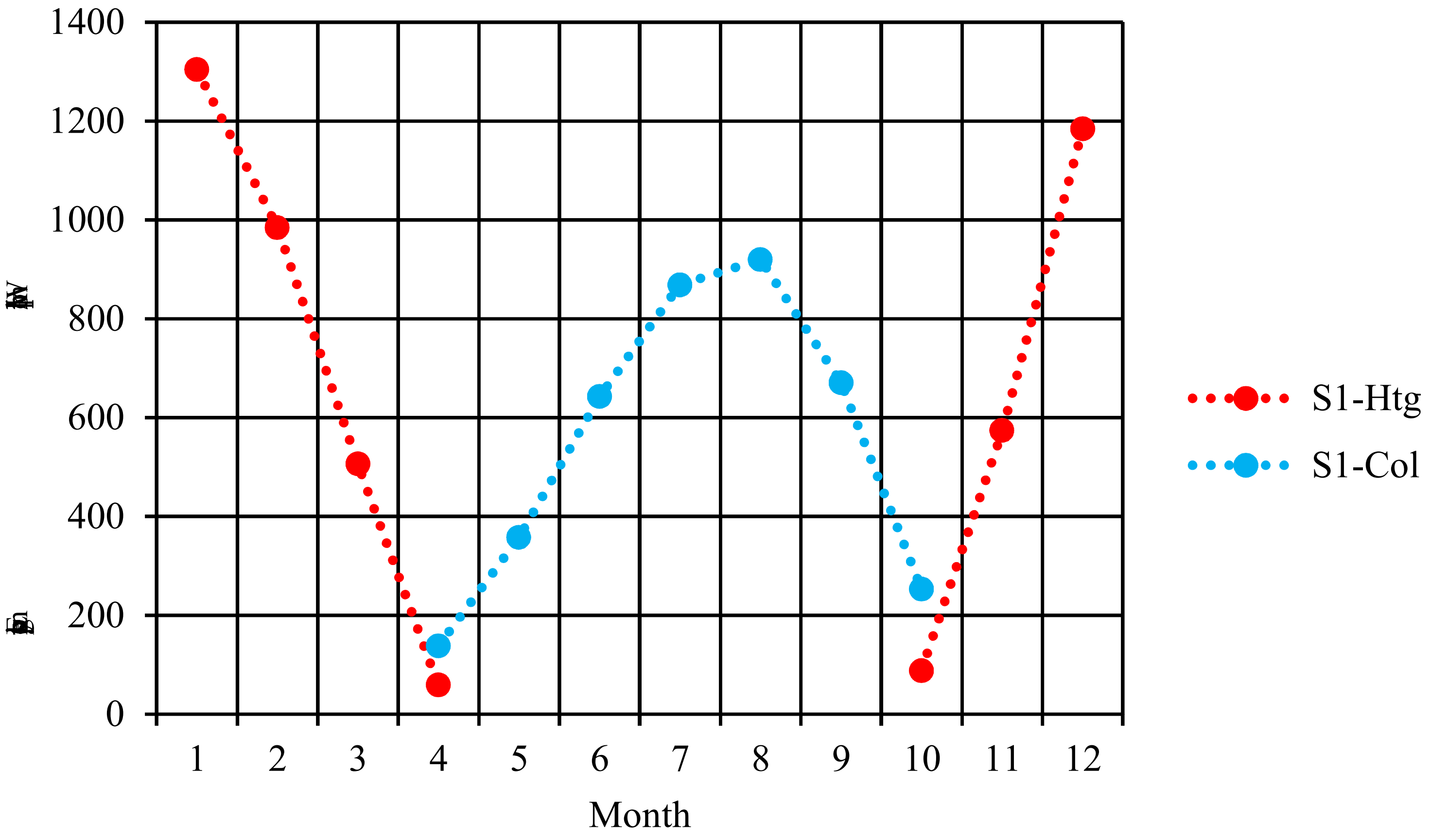


Figure 7. Final energy consumption for heating and cooling for building S1

Results	Heating	Cooling	Total
S1	47.69 kWh/m^{2}a	39.07 kWh/m^{2}a	86.76 kWh/m^{2}a

4. Results

Table 4. Final energy consumption for heating and cooling for building S1, S2, S3

Results	Heating	Cooling	Total
S1	47.69 kWh/m²a	39.07 kWh/m²a	86.76 kWh/m²a
S2	31.82 kWh/m²a	32.13 kWh/m²a	63.95 kWh/m²a
S3	49.22 kWh/m²a	32.85 kWh/m²a	80.07 kWh/m²a

Table 5. Final energy consumption for heating and cooling for building S4

Energy savings	Heating	Cooling	Total
S1	+30.48%	+33.69%	+31.93%
S2	-4.18%	+19.36%	+7.64%
S3	+32.6%	+21.12%	+28.04%
S4	**33.15 kWh/m²/a**	**25.91 kWh/m²/a**	**59.06 kWh/m²/a**

5. Conclusion

Location parameters may in some cases also affect the final energy class of buildings, which should therefore be taken into account at the design stage.

In this paper, basic (on the one hand) and created (on the other hand) loca-tion parameters were used to reduce the annual final energy consumption for heating and cooling of a concrete build-ing located in Kragujevac, Central Serbia.

The study was conducted through a combination of GoogleSketchUp and EnergyPlus, which communicate with each other through Legacy OpenStudio.

The results showed that the heat and cooling energy of the earth-sheltered house can be reduced by 26.29% annually (in winter by 33.27% and in summer by 17.78%).

Using deciduous trees in front of the building can save up to 5.41% annually, mostly due to the reduction in energy required for cooling. Finally, by combining earth-sheltered house and deciduous trees, savings of up to 31.93% can be achieved..