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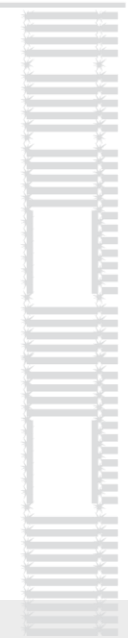
ENERGY CONSUMPTION ANALYSIS IN SERBIAN BUILDING BASED ON THE SOME PRINCIPLES OF PASSIVE SOLAR DESIGN

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INTRODUCTION

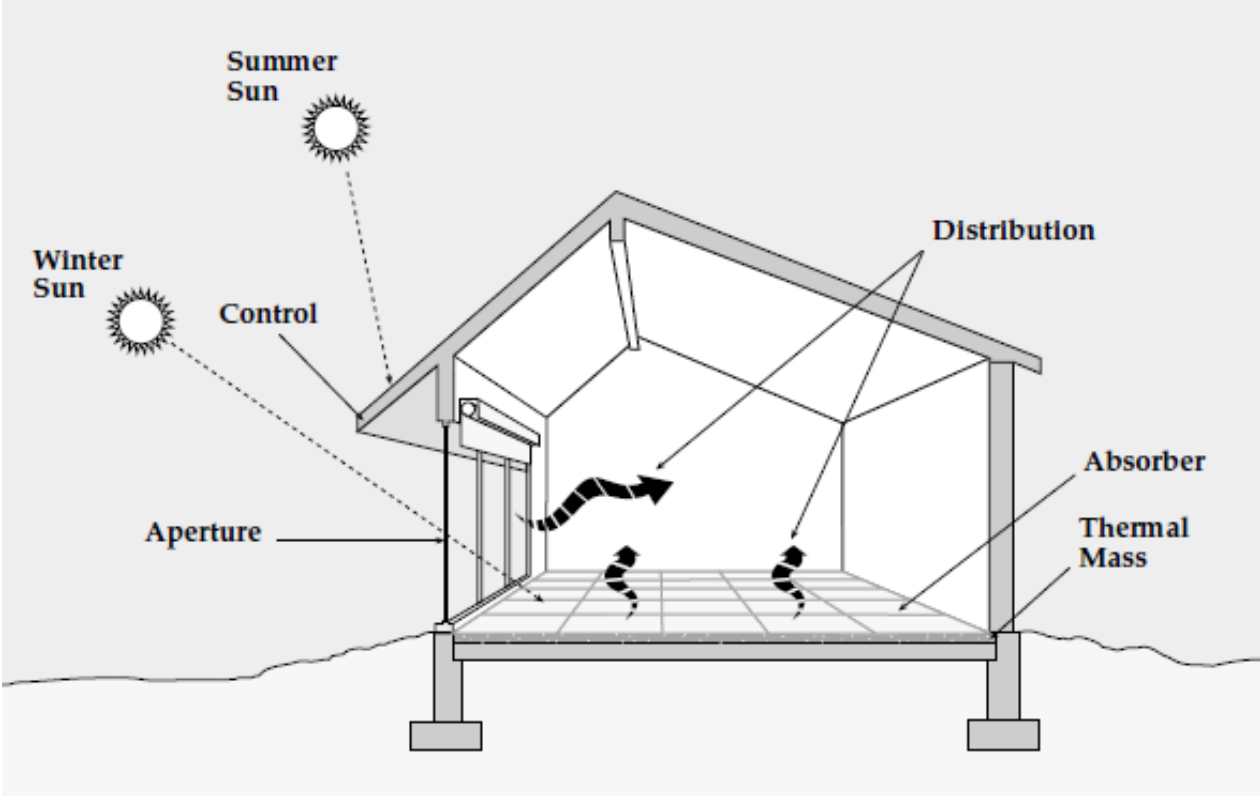
Building sector has a significant share in total energy consumption, so research and development of methods for improving energy efficiency in buildings are very important in the modern world today. Energy consumption in buildings at the global level is 20 - 40% of total energy consumption, while in Serbia it is at the level of even 50 %. This consumption is related to the exploitation conditions of buildings, where the largest consumer is heating system (about 60 % of total energy consumption), than cooling system, installation for the heating of domestic hot water, household appliances etc.



Passive Solar Design

There are three basic types of passive solar design:

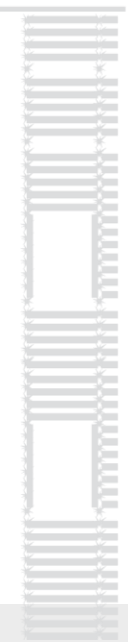
- direct gain
- indirect gain
- Isolated gain



Passive House standards

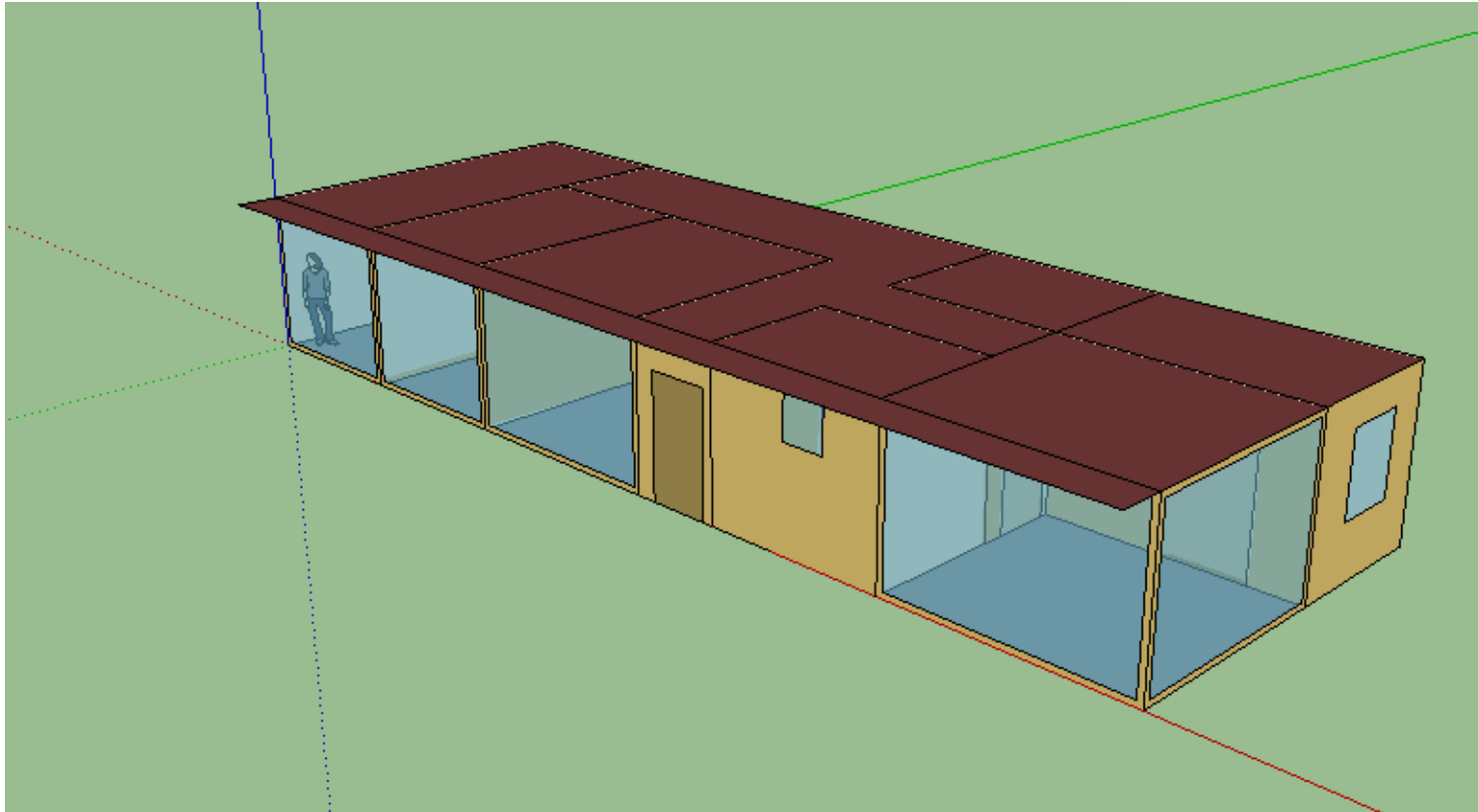
Passivhaus standard for central Europe requires that the building fulfills the following requirements:

- The building must not use more than 15 kWh/m² per year in heating and cooling energy.
- Total energy consumption (energy for heating, hot water and electricity) must not be more than 42 kWh/m² per year
- Total primary energy (source energy for electricity and etc.) consumption (primary energy for heating, hot water and electricity) must not be more than 120 kWh/m² per year

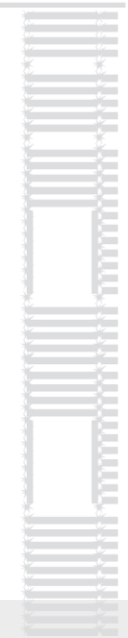


MODEL OF PASSIVE BUILDING IN ENERGYPLUS SOFTWARE

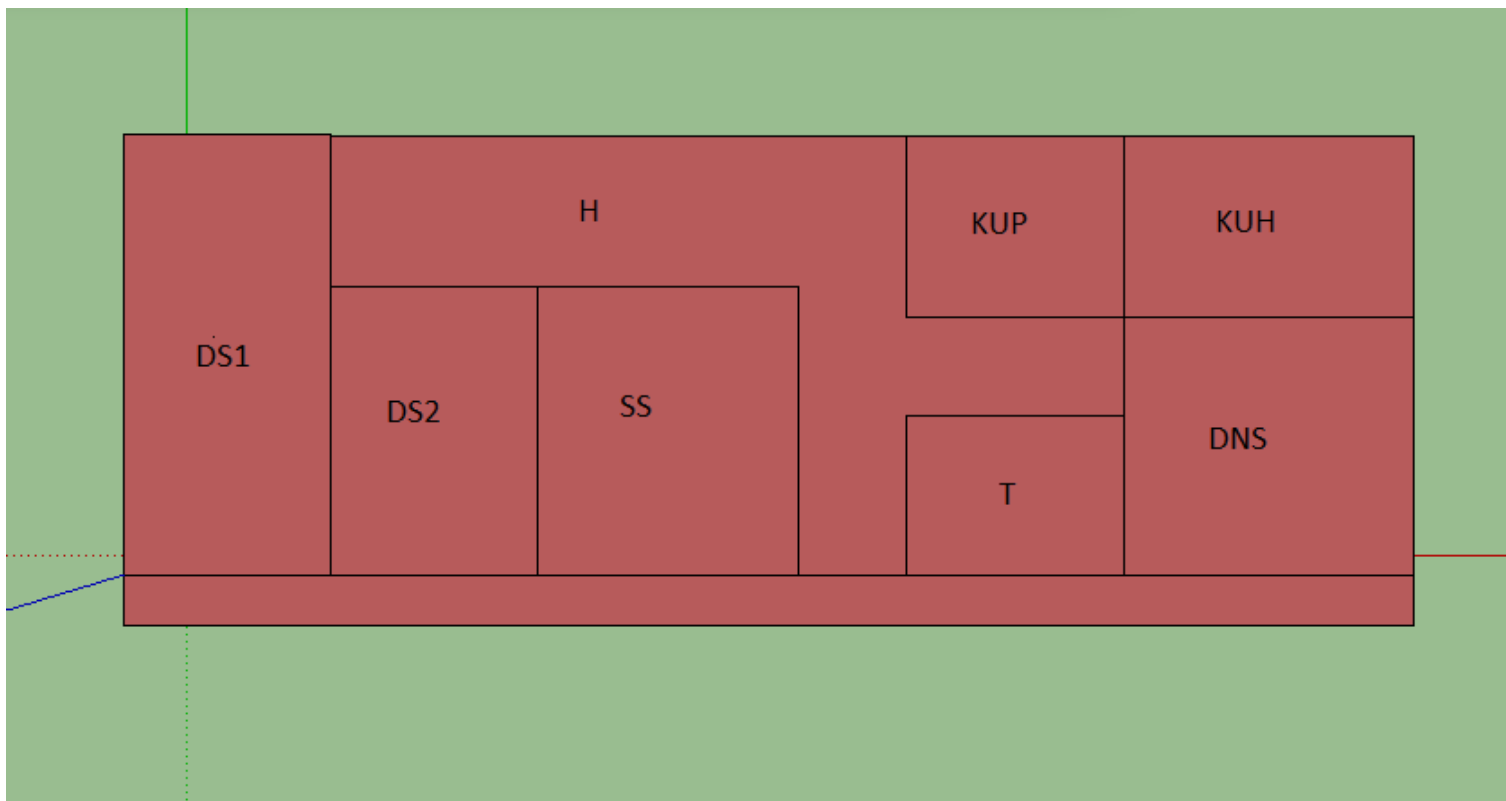
- The building has 8 conditioned zones
- All zones are oriented to the south, except kitchen, toilet and one part of the hall
- The total floor area of the building is $A=108.28 \text{ m}^2$



Modeled building in EnergyPlus software (with passive solar design principles)



- The building has 8 conditioned zones – living room (DNS), bedroom (SS), two rooms for kids (DS1, DS2), kitchen (KUH), bathroom (KUP), toilet (T) and hall (H)



Cross section of the analyzed building – room schedule

BUILDING ENERGY CONSUMPTION

Total energy consumption E_p in building is related to the electricity. Electricity in building is consumed for heating (eh), lighting (el), domestic hot water (DHW) and appliances (eq).

$$E_p = E_{ac} + E_{eh} + E_{eq} + E_{el}$$

where:

E_{eh} - electricity consumption of the electric heating,

E_{el} - electricity consumption for lighting,

E_{el} - electricity consumption for DHW system and

E_{eq} - electricity consumption for the appliances - electric equipment.

Building heating energy consumption per unit of area is

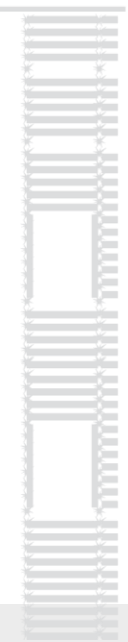
$$E_{pA} = E_p/A$$

Primary energy consumption E_{prim} of the building is

$$E_{prim} = p_{EL} E_p$$

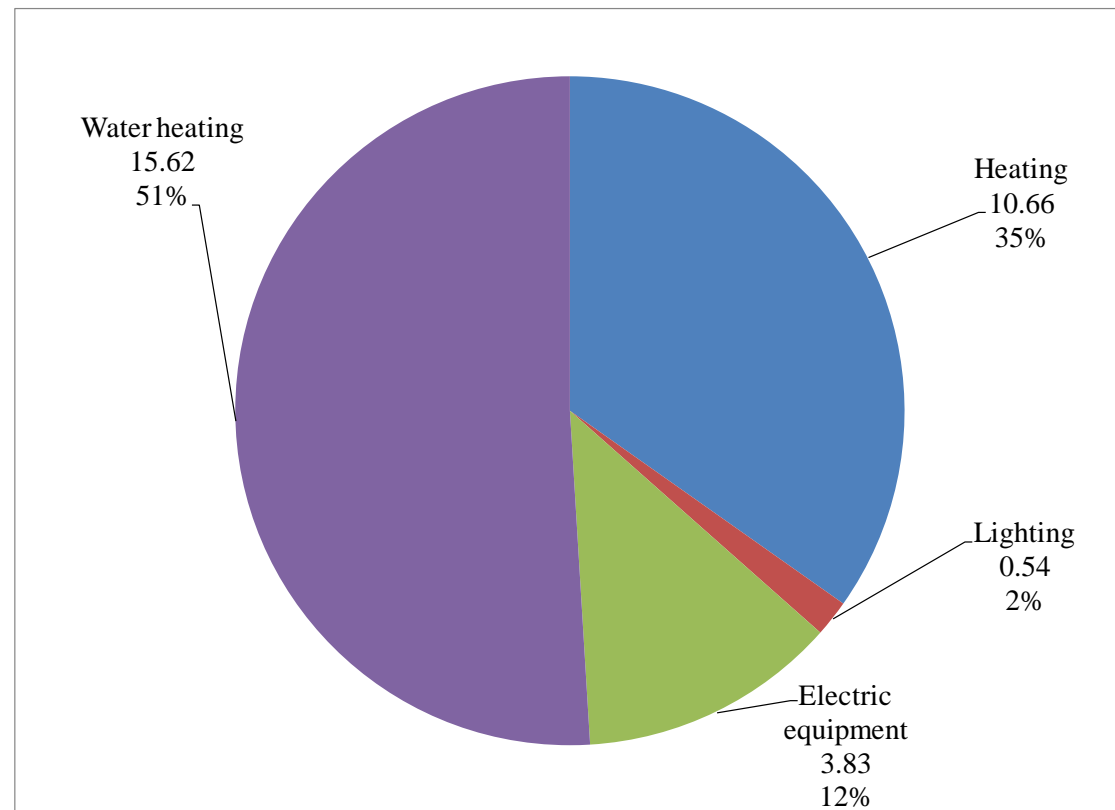
where:

$p_{EL}=3.04$ stands for the primary conversion multiplier for electricity



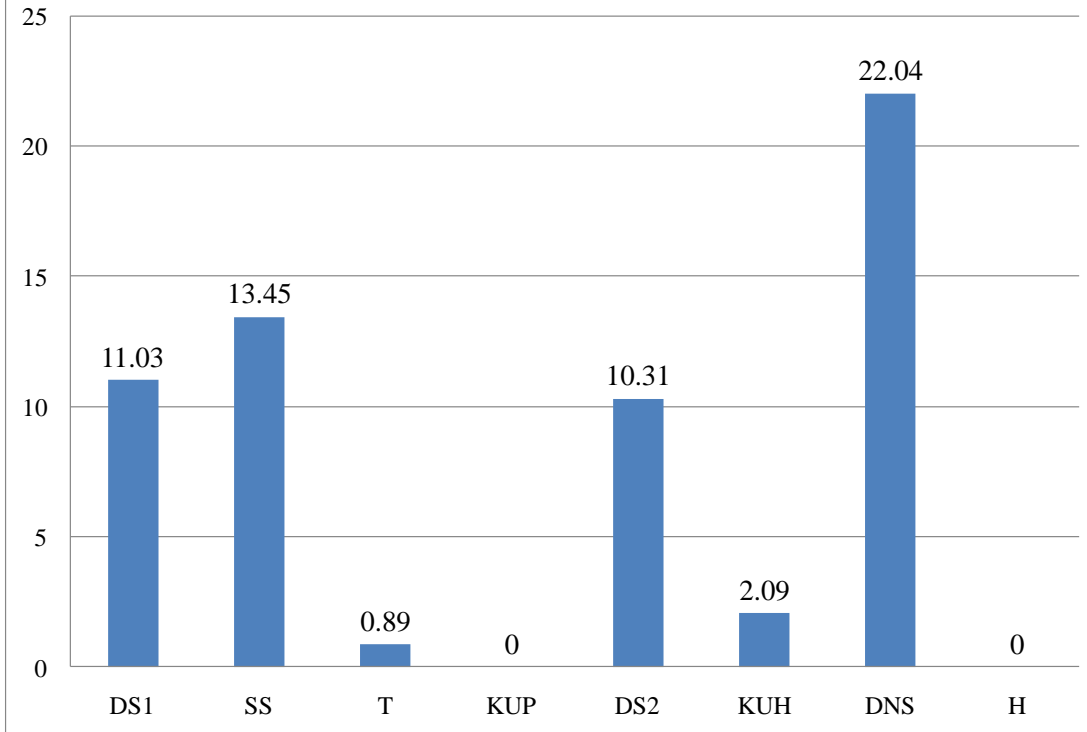
RESULTS AND ANALYSIS

	Energy consumption (GJ)	Energy consumption (kWh)
Heating	10,66	2961,11
Lighting	0,54	150
Electric equipment	3,83	1063,89
Water heating	15,62	4338,89
Total building energy consumption	30,65	8513,89
Total building energy consumption per unit of area	0,283	78,62
Primary energy consumption	93,18	25882,23
Primary energy consumption per unit of area	0,86	239,03
Building heating energy consumption per unit of area	0,098	27,35

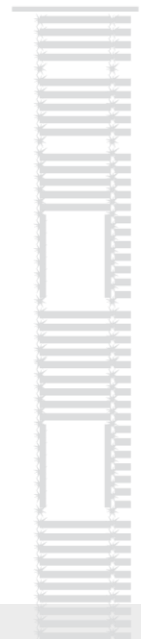
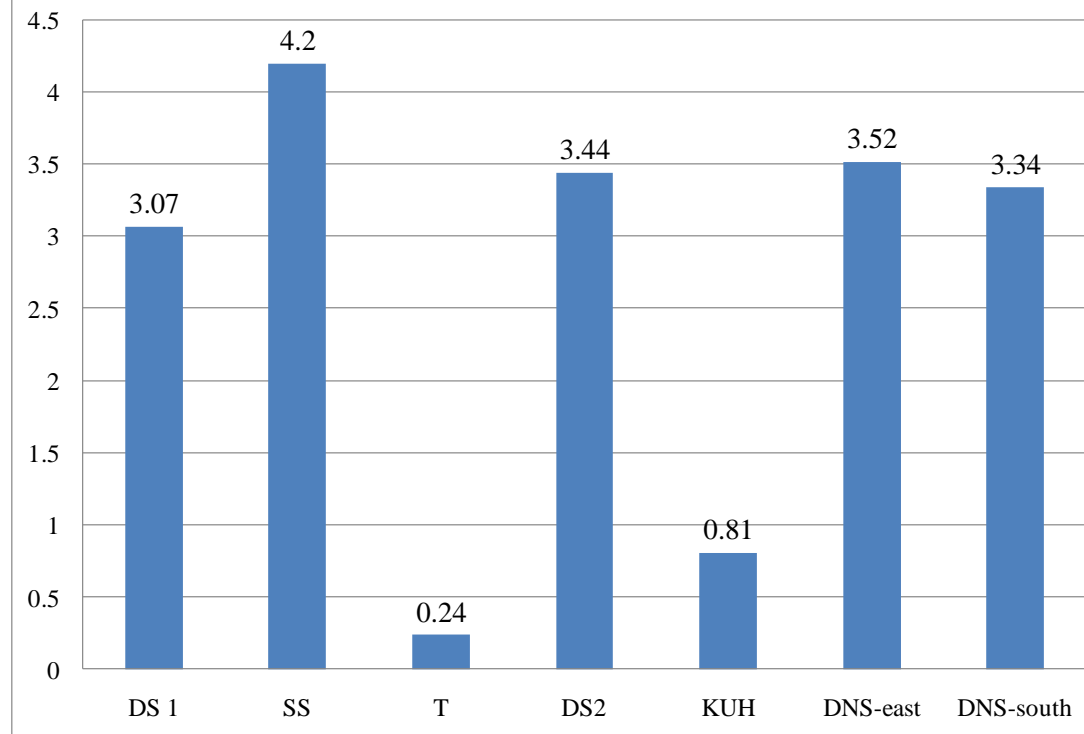


RESULTS AND ANALYSIS

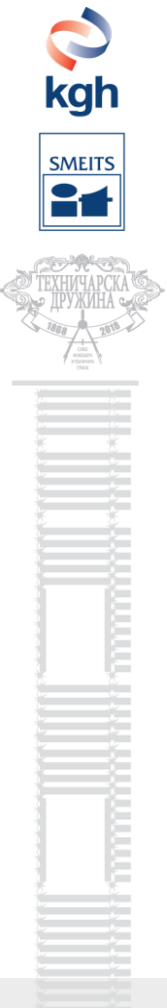
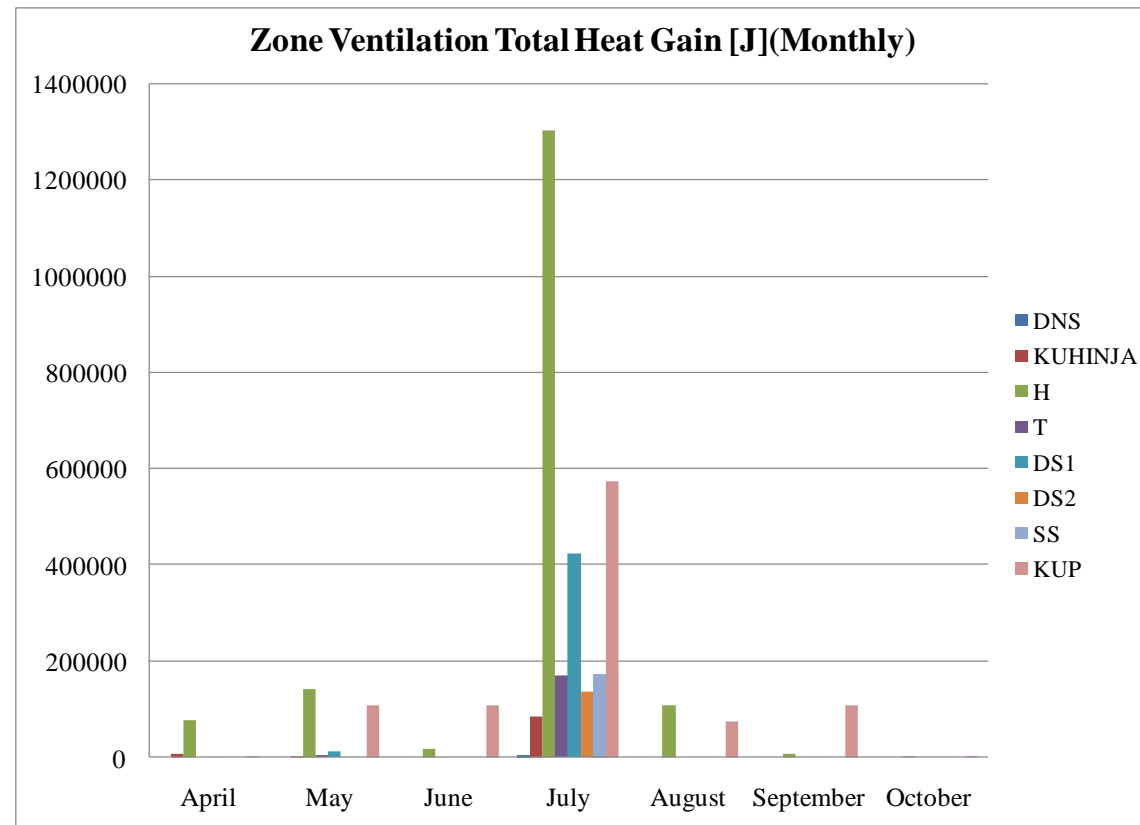
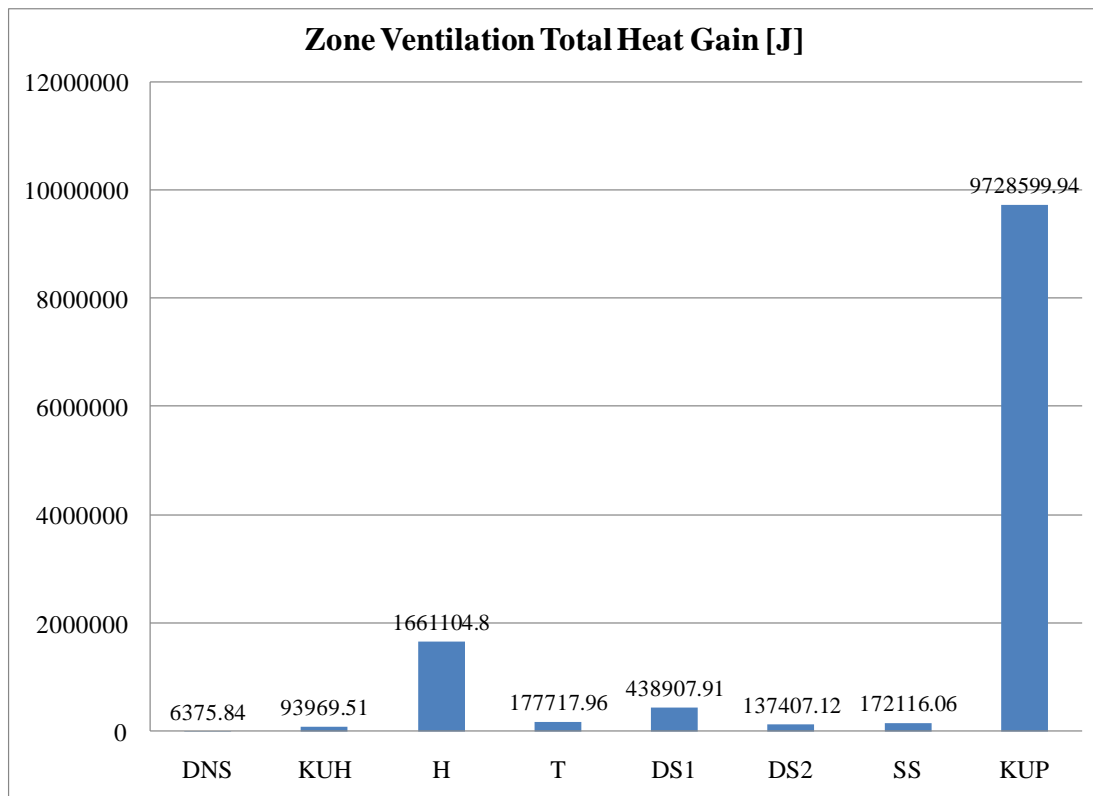
Zone Window Heat Gain Energy[GJ]



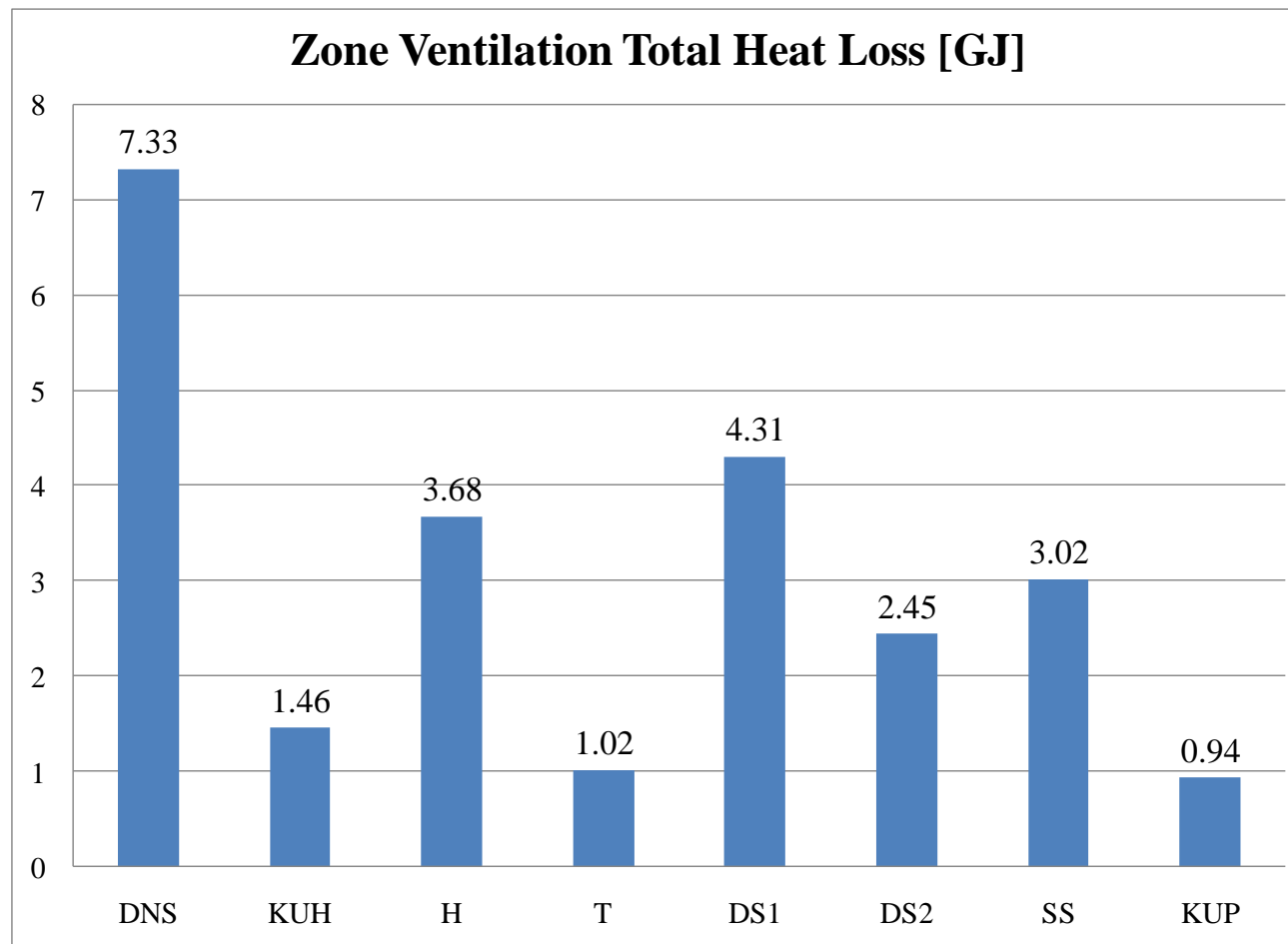
Zone Window Heat Loss Energy[GJ]



RESULTS AND ANALYSIS

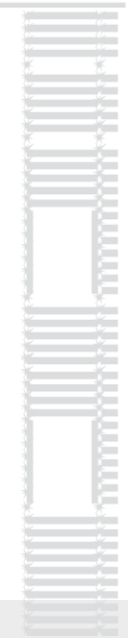


RESULTS AND ANALYSIS



CONCLUSION

This paper presents an analysis of the possibilities for reducing heating energy consumption in residential building, using some principle of solar passive building design. As mentioned earlier, the obtained values for energy consumption in analyzed buildings do not correspond to the Passive house standards for Central Europe, but they represent the possibilities for significant energy saving by implementation passive solar strategies in building design.





Thank you for your attention!!!