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Simulation of the energy consumption of a building in the form of a honeycomb

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This paper deals with the energy consumption in the residential building in a Mediterranean climate with half level system which is a typology that has not been studied before referring by analogy to the honeycomb. For this purpose, we used the finite volume method presented by a numerical simulation on the EnergyPlus/openStudio software. Two simulations were made, the first one presents the current use of the house and the second one shows the energetic use with the passive system that was developed with the modifications applied on the shape of the building.

The results show that the cooling needs have decreased by 40% and the consumption per hour in August goes from 2.3 kWh to 1.4 kWh. Finally, it was found that the modifications applied on the building really decreased the energy consumption by 30%.

1.Methodology

A.Presentation of the case study:

Our case study is located in the center of Boumerdes, climatic zone A (according to the DTR). The building is designed with the system of half level with a stairwell in the middle, with an area of 230 m² and volume of 708.066 m³

Fig.1. geographical location of the case study

B. Method of calculation:

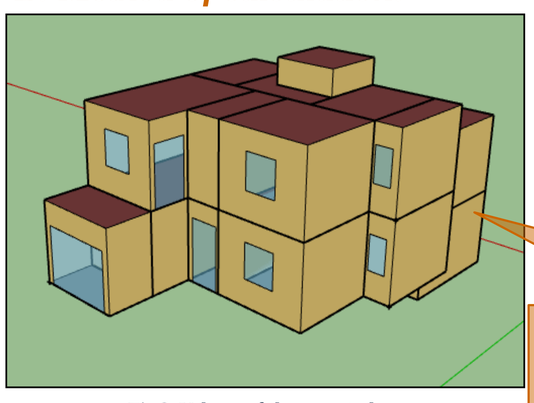

Fig.3. Volume of the case study

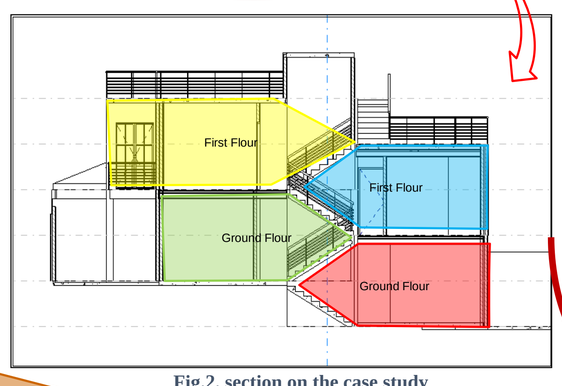

Fig.2. section on the case study

The volume integrals of a divergence term are transformed into surface integrals. These flow terms are then evaluated at the interfaces between the control volumes and the flows at the interfaces are approximated by an approximated by a numerical flux function

2. Results and discussion

A.current scenario of the study case

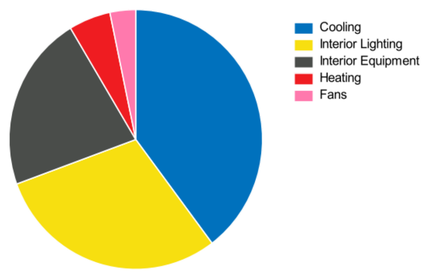

Fig.4. The current energy use of the house

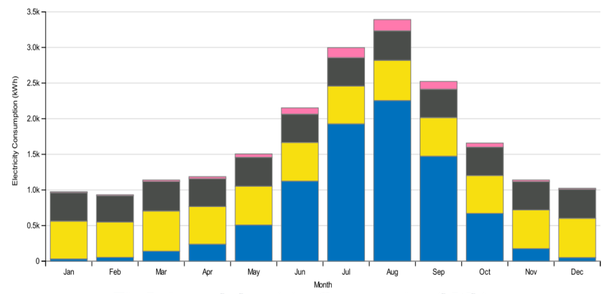

Fig.5. Annual electricity Consumption (kWh), current case

B. The proposed scenario

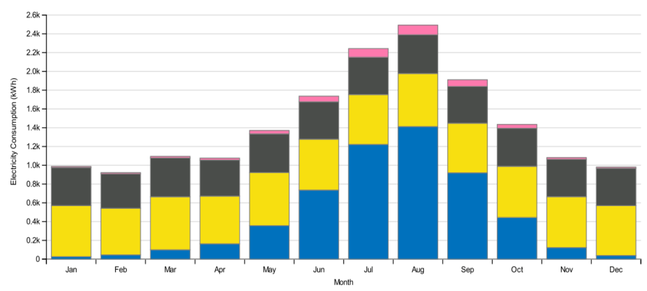

Fig.6. Annual electricity Consumption (kWh), after modifications on the shape

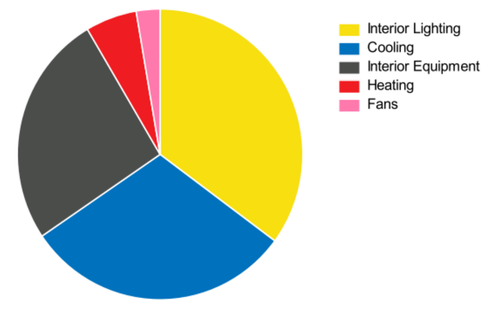

Fig.7. The energy use after modification

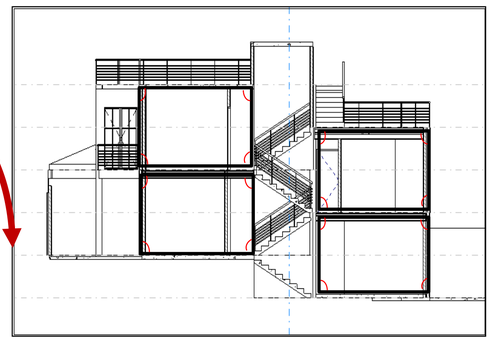

Fig.8. schematic section on the changes made to the shape

The aim of this work is to minimize the consumption of air conditioning by intervening on the geometric shape of the different rooms of the building. This has created a hexagonal shape that resembles the shape of the honeycomb, hence the choice of the circular shape at the corners. This is a new idea that has never been studied before.

The modeling and simulation of the thermal comfort of our house shows that it consumes a lot of energy (up to 3.4 kwh per hour). Depending on the shape of the house, we proposed a passive solution or we used the thermal comfort system of the honeycomb and we applied it to our case study (analogical method). The results showed that this system is effective, it managed to decrease the cooling needs up to 40%. As the software used is very detailed, the calculation method is satisfied and the results are reliable. The applied method has shown very promising results, so we can be inspired by nature and use the hexagonal shape of the honeycomb to work on the thermal comfort of buildings.