Thermal behavior and energy evaluation of an ecological building located in Dakar, Senegal

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Abstract

Our paper present a first evaluation of the thermal behavior of an ecological building in the suburbs of Dakar, Senegal. Outdoors and interior temperatures and relative humidity of an unconditioned thermal zone have been measured for three months (December, January and February). Givoni diagrams for indoor and outdoors conditions have been produced to evaluate the thermal comfort. Time lag and decrement factor for a representative day for each month are given. Photovoltaic production and electrical consumption of the building during these selected days are measured in order to evaluate the building electrical autonomy.

Introduction

The building sector is one of the sectors that consume a lot of electrical energy and is a major emitter of greenhouse gases. This sector is therefore one of the responsible for the climate changes observed. However, although the contribution to climate change of States like Senegal remains low, these States have to develop strategies of resilience to these climate changes. Among these strategies, we can note the construction of bioclimatic and ecological buildings.

This paper aims to evaluate the thermal behavior of an unconditioned zone of an ecological residential building in the suburbs of Dakar. The electrical production of the photovoltaic generator and electrical consumption of the building are measured in order to assess the building electrical autonomy.

Materials and Methods

Fig.1: Weather station

Fig.2: Thermohygrometer

- Weather station for outdoors conditions
- Thermohygrometer for indoor conditions
- Hybrid Invertor connected to a computer for electrical measurements

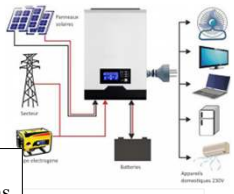

Fig.3: Hybrid invertor

Results

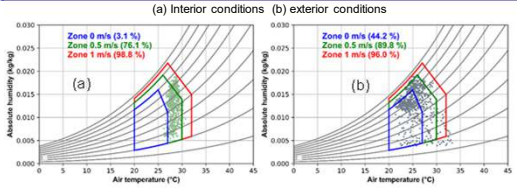

Fig. 4: Givoni bioclimatic chart for December

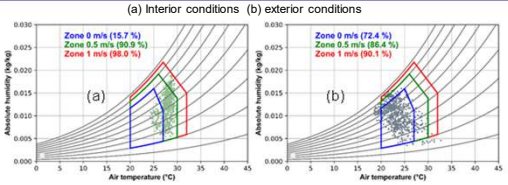

Fig. 5: Givoni bioclimatic chart for January

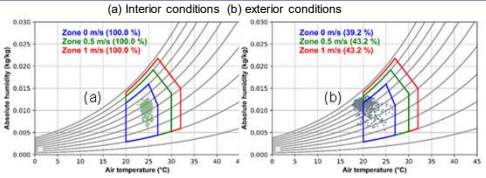

Fig. 6: Givoni bioclimatic chart for February

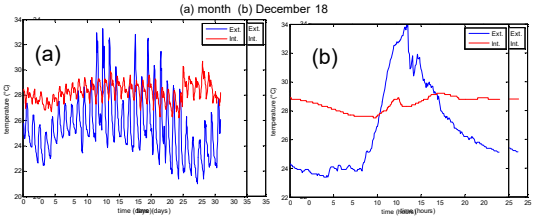

Fig. 7: Temperature variation for December

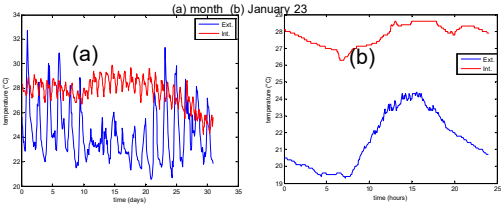

Fig. 8: Temperature variation for January

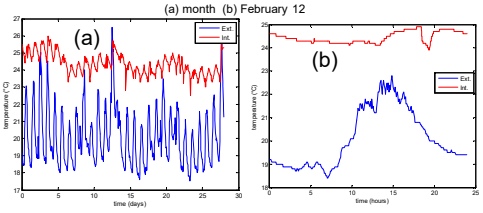

Fig. 9: Temperature variation for February

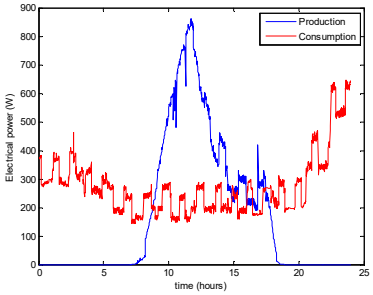

Fig. 10: Electrical power variation for December 18

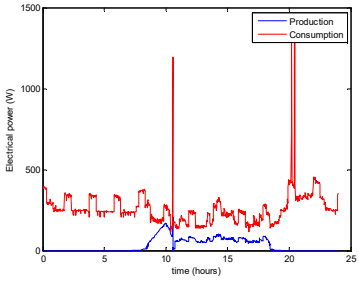

Fig. 11: Electrical power variation for January 29

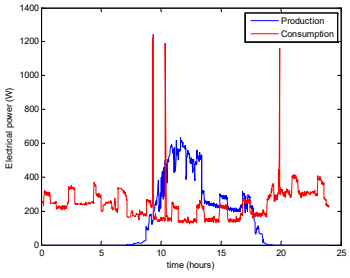

Fig. 12: Electrical power variation for February 12

Conclusion

- ❑ Givoni digramm charts show that the thermal zone of the ecological building is comfortable for the three months. The points are less scattered inside than outside the building.
- ❑ The interior temperature has smaller amplitudes than the exterior ones and time lag can reach 3 hours. We can assess that the building has a bioclimatic behavior.
- ❑ For January and February, interior temperature is always above the exterior temperature. This is due to solar radiation.
- ❑ The PV production is less than electrical consumption for selected days. All the potential of PV production is not used due to the low battery capacity installed.
- ❑ This study will be extended for at least one year to assess the thermal behavior of building during the summer.
- ❑ The main facades being oriented towards the South-East and the South-West. To protect them from the radiation, we are planning to make a vegetation of the of the fence wall.

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