THERMAL EVALUATION OF A VENTILATED BUILDING USING DYNAMIC SIMULATIONS.

Norma A. Rodriguez-Muñoz[1,2], Mario Nájera-Trejo[2], Olivia Alarcón-Herrera[2], Ignacio R. Martin-Dominguez[2]

1. Consejo Nacional de Ciencia y Tecnología, Cátedras CONACYT, norma.rodriguez@cimav.edu.mx; 2. Centro de Investigación en Materiales Avanzados, Unidad Durango

Abstract

A thermal analysis of ventilated office building was performed by the use of a dynamic simulation software. This work focuses on the analysis of a ventilation strategy, contribution to the thermal performance of a 2000 m^2 building. The studied building is located in a region within the BS1kw climate according to the Köppen climate classification. In this climate, commonly referred as steppe, both air cooling and heating is needed in order to provide a satisfactory thermal comfort condition throughout the year. Within this weather it is possible to incorporate several energy saving strategies so the heat gains and losses can be calculated. The analysis starts with the incorporation of basic bioclimatic notions and the selection of commonly used construction and glazing materials. Several energy saving strategies were established; this strategies, such as the study of different materials and natural ventilation during the warm season. The results show hourly mean temperatures and energetic demands due air conditioning during the course of a year.

Introduction.

Over the past decades, the design of buildings have been occurring with little to none appreciation of the use of natural resources. The Intergovernmental Panel on climate Change (IPCC) issued an article that addressed the role of individuals in climate change, stating that the global greenhouse gas emissions increased around 70% between 1970 and 2004. Buildings demand of energy grows rapidly, between 1990 and 2005 the energy consumption in OECD countries increased by 23 % and electricity use by 54% [1]. Consequently the design of sustainable buildings and the application of bioclimatic concepts and energy saving measures need to be implemented.

In Mexico, bioclimatic design is often underestimated as a valid approach within the practice of architectural firms. Where such studies are offered only as application of concepts, design and passive elements, not taking into consideration that calculations need to be made so the building's performance can be confirmed. In this study a multidisciplinary approach is executed where different disciplines integrate their knowledge in the design and calculation phase.

System conditions and methodology.

This work focuses on the analysis of the materials contribution to the thermal performance of a 2000 m^2 building through the dynamic simulation software TRNSYS 17.02.0004. The building has 2.70 m high storeys and a plenum or ventilated chamber of 0.90 m high. The climatic parameters, such as hourly mean temperatures, humidity, solar radiation and wind speed were provided by the weather data software Meteonorm. The building was divided into thermal zones, which are described in Figure 1. In this figure, the transversal cut and floor plan of the building are shown.

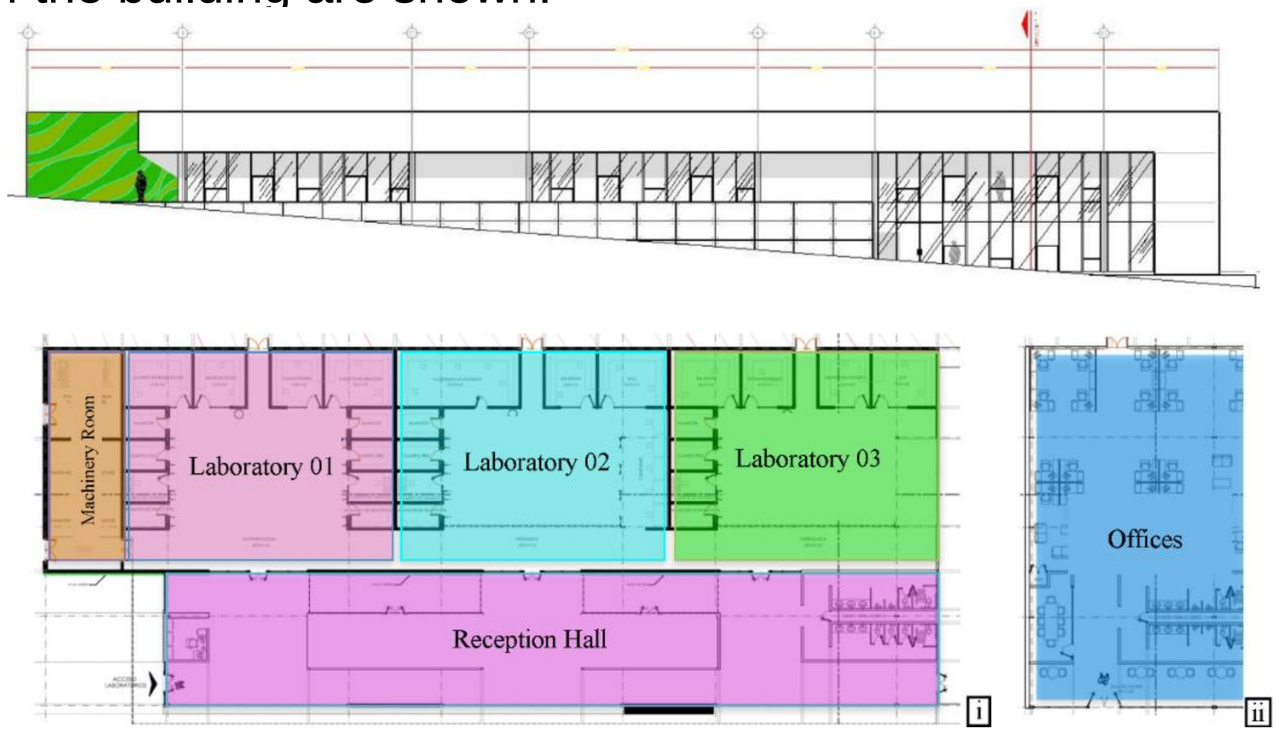
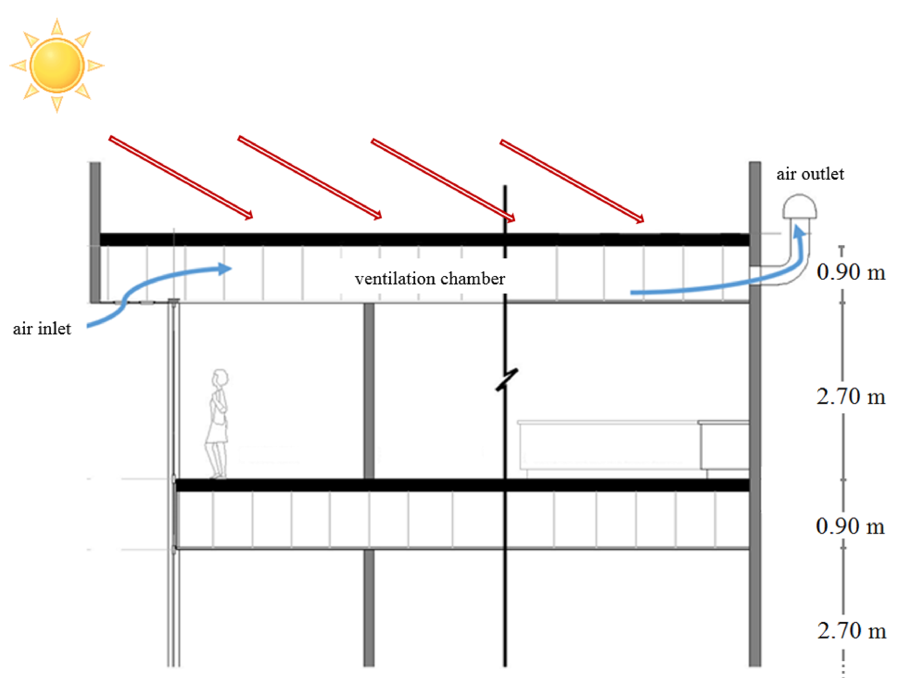


Fig. 1. Transversal cut (a) and floor plan with the defined thermal areas (b).



An operation program was set on the use of the heating and cooling systems, the schedule was from Monday to Friday from 7 to 19 hours. The schedule regulates the amount of time when the air conditioning systems are truly used. A ventilation strategy was implemented for the warm months, which for this region are from May through the end of August. The ventilation strategy is represented in Figure 2.

Results.

The results include the analysis of the mean hourly temperatures and the thermal loads due to the building conditioning when the temperature criteria is not met. The temperature conditions were set to a thermal comfort range of 20-28°C (Figure 3). The results include the analysis of the mean hourly temperatures in a yearly basis, for the warm months (Figure 4) and for the hottest week of May (Figure 5).

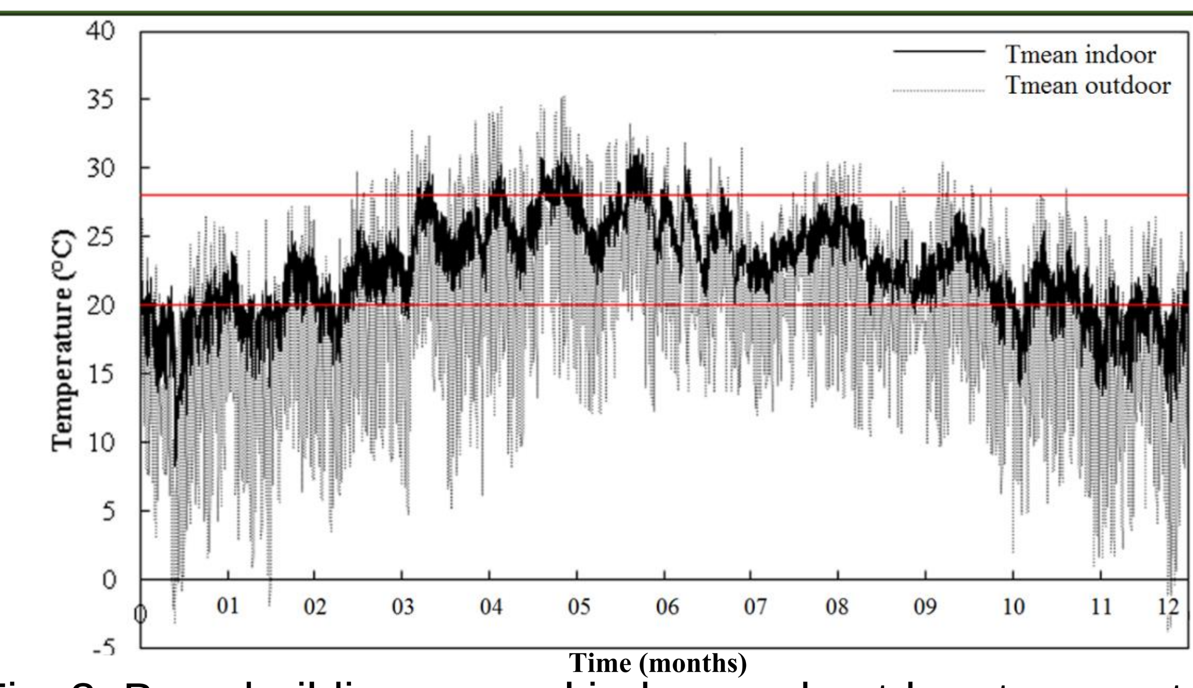


Fig. 3. Base building, annual indoor and outdoor temperatures.

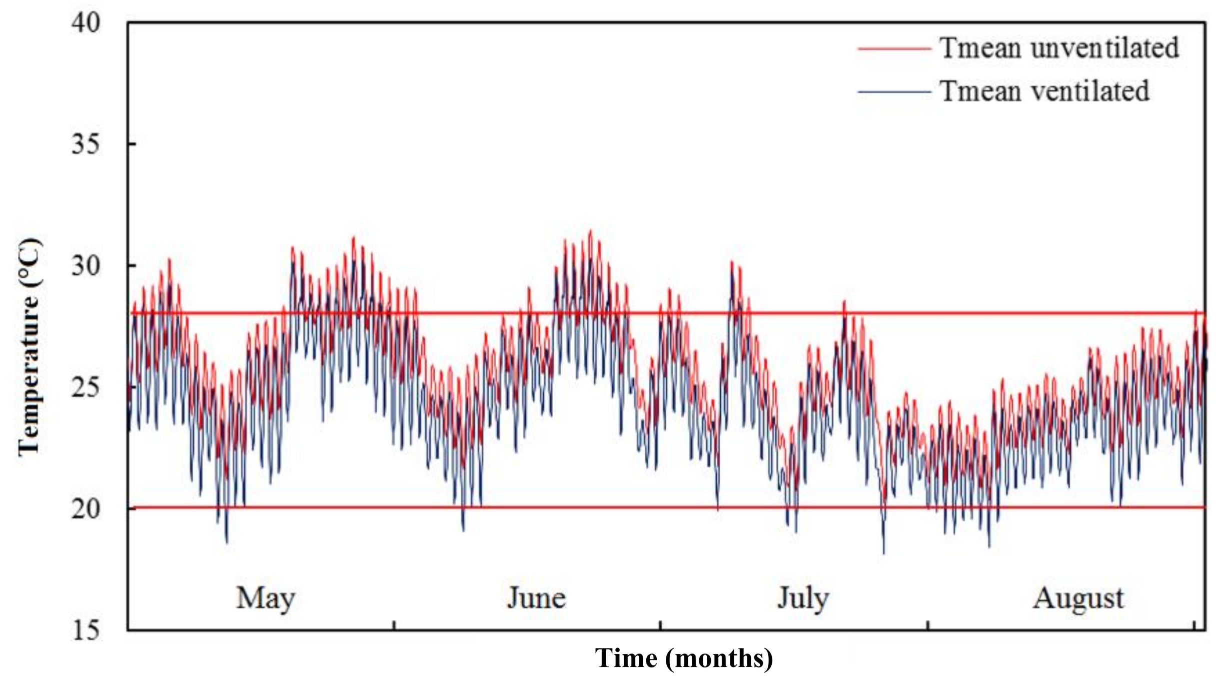


Fig. 4. Indoor mean temperatures during warm months.

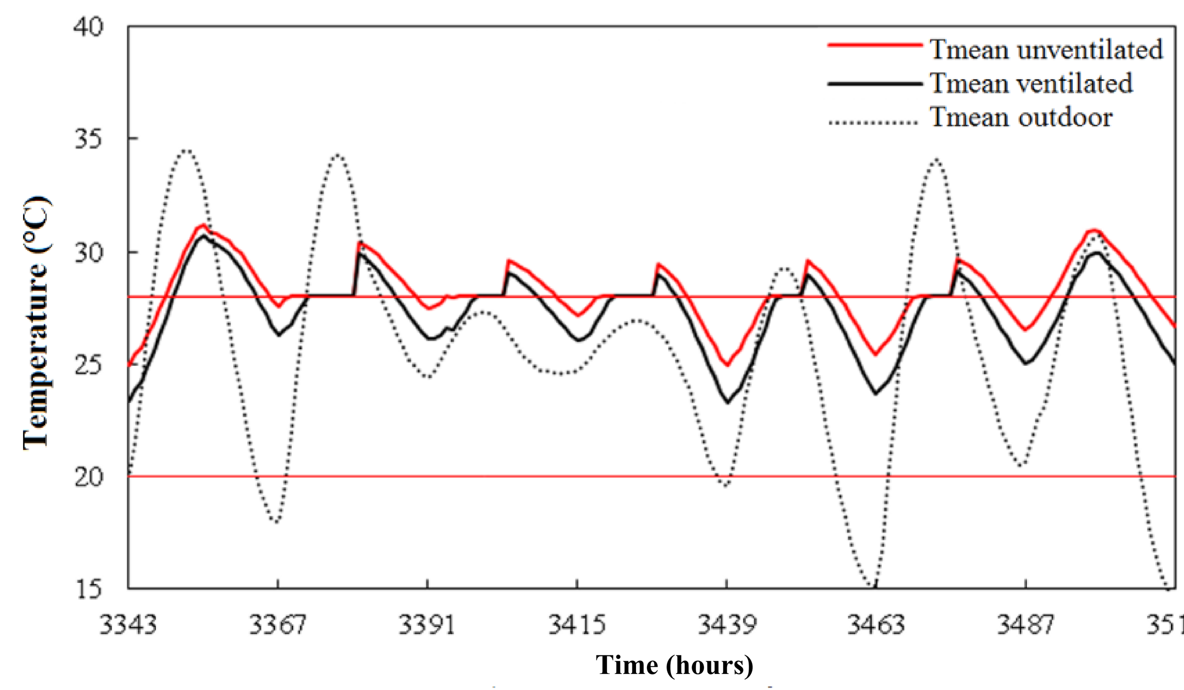


Fig. 5. Hourly mean temperatures during the hottest week of May.

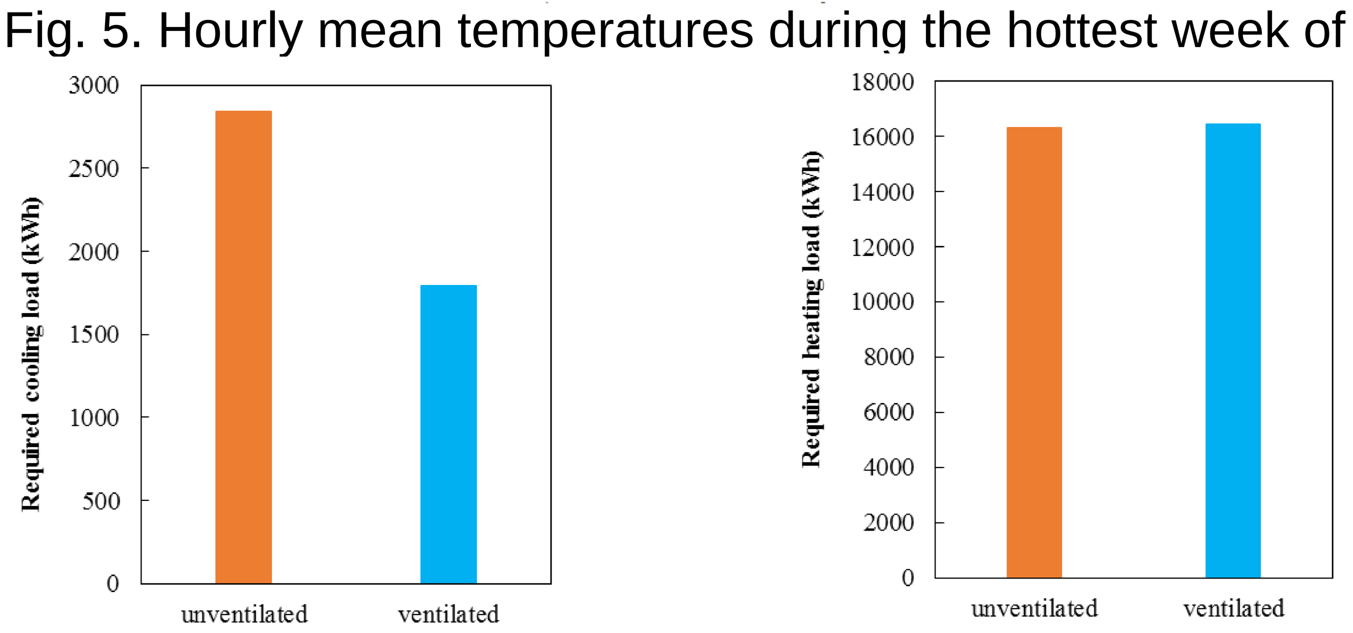


Fig. 6. Required cooling (a) and heating (b) loads.

Conclusions.

A thermal analysis of a building for the Centro de Investigación en Materiales Avanzados (CIMAV) at the state of Durango, México by means of dynamic simulations was carried out. Several energy saving strategies were studied; as a result, it was found that a ventilation arrangement on the second's floor ceiling during the warm season was an effective approach to reduce the energy consumption due to air conditioning during the warm months. A 37% energy expenditure is avoided due the ventilation strategy; however, the heating needs raised approximately 1% because of the implementation of this strategy. This setback can be avoided if a temperature control regulates the incoming air's temperature at the entry grids.

Acknowledgements.

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