Agradecimientos

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Capítulo 1

Introducción

1.1. Objectives

General objective:
Implement, validate y documentate a direct evaporative cooling model in energy plus.
Especific objectives:

- Describe the direct evaporative cooling model to be implemented.
- Develop a simulation model for the direct evaporative cooling strategy.
- Implement the direct evaporative cooling model into EnergyPlus.
- Validate model with experiments Elaborate a detailed implementation methodology for the model.

1.2. Thermal comfort and building energy consumption

1.3. Evaporative cooling

- What is it? and where it is applied
- Diference between direct and indirect
- Current technology

1.4. Buildings simulations and EnergyPlus

- Importance of building simulations
- EnergyPlus description

1.5. Motivation

- Evaporative cooling in EnergyPlus
- Pappit description (?)

  PAPIIT, si, que eres participe de ese proyecto, y tiene que ir el numero del proyecto y el nombre en los agradecimientos, por la beca.

Capítulo 2

Literature review

2.1. Psychrometric aspects

- Ideal gases
- Mixed gases
- Psychrometric aspects
  - Air-vapour mix
  - Dalton law
  - Humidity ratio
  - Relative humidity
  - Enthalpy of atmospheric air
  - Psychrometric chart and different temperatures.

2.2. Air conditioning of spaces and thermal comfort

2.3. Direct evaporative cooling

2.4. Energy plus

Capítulo 3

Methodology

3.1. Project description

- Papiit
- Temixco
- Grafica de radiación
- Hay potencial
- cafetería modeling
- aspersores, direct evaporative modelling, foto del osm

This thesis work is a product of the Papiit project, Estudio teórico-experimental del enfriamiento evaporativo en eficicaciones. Objetivo de Papiit.

This project study and aim to simulate the evaporative cooling process that takes place in the sprayers located within the IER cafeteria area. As the IER is situated in Temixco, a township of the state of Morelos, the numerical experiments were carried out with local data.

Temixco is a city located in the mexican state of Morelos, it borders with Cuernavaca and Jiutepec. It has a latitud of 18.85°, -99.22° of longitud, 1253 MSL and 89,869 km^2 of territorial extension. According to the population and housing census made in 2020 by the Instituto Nacional de Estadística, Geografía e Informática (INEGI)[1]the city has a population of 122,263 people. Its climate is form by to kinds; warm sub-humid and semi-warm sub-humid climate [2]. The temperature range is 18-24°C and the precipitation range, which most is in summer, is 800-1200 mm.

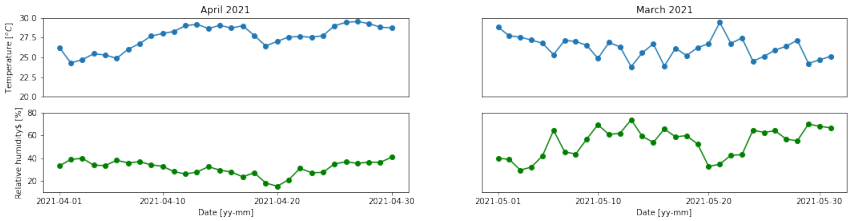


Figura 3.1: Mean temperature and relative humidity in March and April 2021 according to ESOLMET.

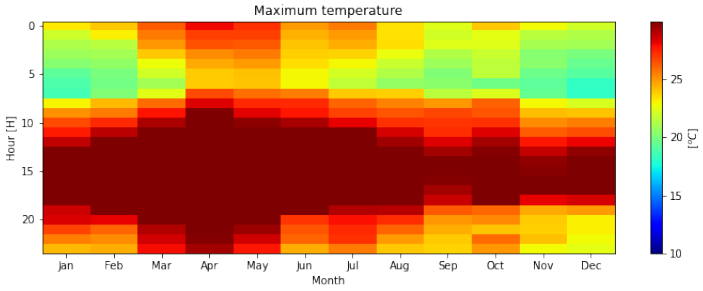


Figura 3.2: Temperature, IER 2021 according to ESOLMET.

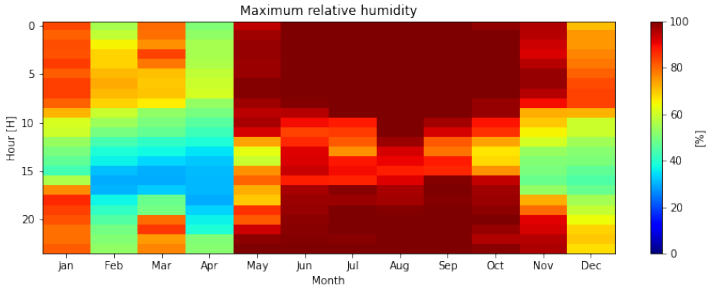


Figura 3.3: Relative humidity, IER 2021 according to ESOLMET.

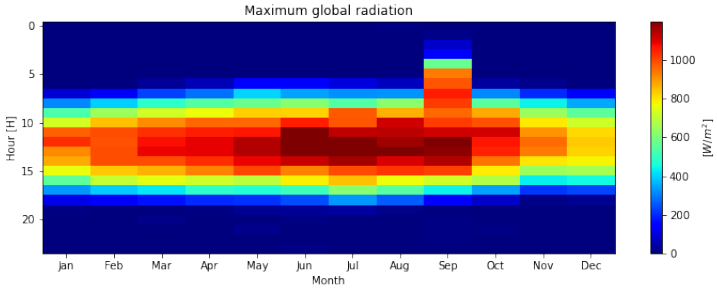
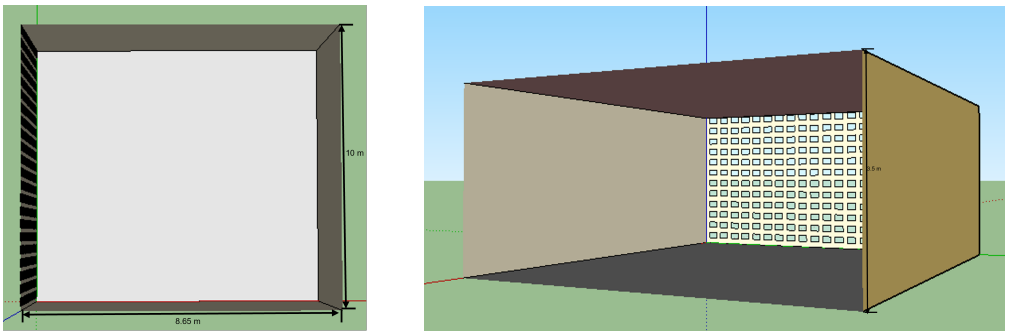


Figura 3.4: Global radiation, IER 2021 according to ESOLMET.



(a) Upper view (b) Side view

Figura 3.5: Cafeteria dimensions

Experiments and measurements made to study evaporative cooling effect were carried out in the IER´s cafeteria in Temixco, Morelos. It corresponds the second of four stories of a rectangular building which principal façade is oriented to the east, facing Quetzalcoatl place, with an 6° angle deflected clockwise.

The cafeteria it's a space of constant traffic of people. Although kitchen has a schedule of 9 am to 5 pm, it is used to be people sitting there all day. However, the most crowed hours are 2-4 pm which correspond mealtime for the most people in the institute. While the number of people tends to vary according to the time and day, the human activity carried out in this space does not involve a higher charge of energy than that of people seated. Of course, this is true without involving kitchen activities.

The cafeteria is a space with 8.65 x 10 square meters of area and 3.5 meters high, without taking account the kitchen area. The space that is described as a cafeteria is a semi-open space. It has a wall that points to the south, the half separation of the kitchen to the north, a wall with latticework to the west and the part to the east, in front of the Quetzalcoatl square, is open.

The lattice on the west wall is made up of 264 openings (12x22). The size of each opening is 15x22 cm.

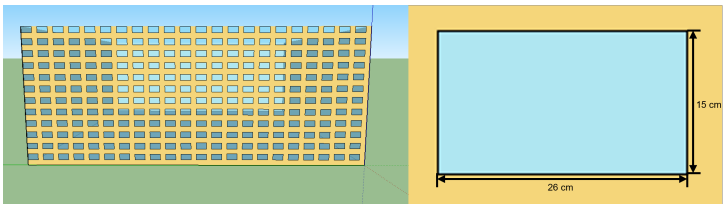


Figura 3.6: West wall

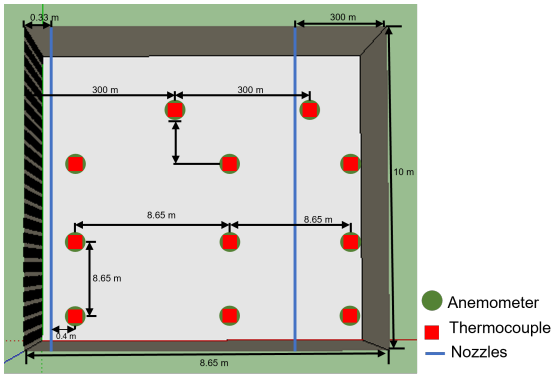


Figura 3.7: Sensors location

The evaporative cooling in the cafeteria is carried out by an air conditioning system consisting of 30 brass nozzles installed in a nylon pipe circuit. They are installed to the east and west of the cafeteria, at the entrance and next to the lattice. In each part there are 15 nozzles installed at a height of 3.3 m. This system is divided in four subsystems:

- Filtration system: filters polluting particles from the water and measures water consumption.
- Nebulization system: it is responsible for the dew drops through a control system that maintains the circulation of water at 6,895 KPa and a flow rate of 1.89 L/min.
- Thermocouple system: measures the temperature at certain points in the cafeteria
- Control system: controls the electric valves that allow the circulation of water. The data acquisition from the sensors is carried out by the thingsboard platform. To carry out the measurements there are three types of sensors: anemometers, thermocouples type T and humidity sensors.

3.2. Numerical experiments

Hay que esperar un poco, pero podría ser numerical simulation and validation... pero ya que tengamos más información lo consideramos.

También hay que considerar si habrá algunos apéndices, reportando tus libretas, me parece interesante documentar tu proceso de aprendizaje.

3.3. Validation process

Capítulo 4

Results

Capítulo 5

Conclusions