Central air cooler sizing

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ABSTRACT
The average increase in temperature on the planet has shown a growing need for the use of machinery for thermal comfort. However, there is still a conflict in the search for well-being due to the high energy consumption that a poorly dimensioned equipment can generate. Therefore, the objective of this work is to size a central air conditioner in the most optimized way, so that the air conditioning occurs uniformly in the rooms, with independent air direction and low noise emission, since the refrigerator will be located in a specific room for it.

Keywords: Refrigeration, Sizing, Thermal Comfort.

1 INTRODUCTION

The average increase in temperature on the planet has shown a growing need for the use of machinery for thermal comfort. However, there is still a conflict in the search for well-being due to the high energy consumption that a poorly dimensioned equipment can generate. Therefore, the objective of this work is to size a central air conditioner in the most optimized way, so that the air conditioning occurs uniformly in the rooms, with independent air direction and low noise emission, since the refrigerator will be located in a specific room for it. It is a quantitative study, in which the objectives are achieved numerically, developed as a final project for approval in the discipline of Refrigeration and Air Conditioning, an optional subject of the Mechanical Engineering curriculum, in which the students obtained the theoretical framework necessary for the production of this work, together with the support of the professor.

The application of this study was a commercial townhouse with an area of approximately 208 m², with ten rooms to be refrigerated, located in the municipality of Uruguaiana, Rio Grande do Sul. For the design of the air conditioner, the thermal comfort temperature chosen was 24.5ºC and relative humidity was 50%. Seeking to cover the greatest thermal variations, the month of January at 1 pm was chosen, because according to the ASHRAE website, it is the moment that has the highest temperature of the year, of 36.1ºC.

With the floor plan of the place, it was observed that the façade faces east and that the external walls are of light colors, thus being able to calculate the incoming thermal load.

The dark-colored ceiling, composed of gypsum and fiber cement tiles, has direct sunlight, and the heat produced can be calculated using the Temperature Difference for Cooling Load (DTCR) method. To calculate the insolation of the glasses, the Solar Gain Factor (FGCS) and Cooling Load Factor (FCR) methods were used, taking into account that there are no curtains, only a marquee that casts an external shadow. For the doors, air infiltration and the thermal conductivity of each one were considered, with five glass doors and one wooden gate. By analyzing the heat gain in the sensitive and latent form, it was possible to calculate the internal load generated by electronic equipment, such as computers, refrigerators, card machines and vertical freezers, observing the maximum power dissipated by each one. Lighting contributes through convective and radiant heat, with up to twenty-three luminaires dissipating energy.

The air renewal considered the movement of eleven people between all environments, in which the heat gain of the occupants is for light work activities, to a warehouse with non-smokers. Tools such as the psychrometric chart, manufacturer's manuals, and Microsoft Excel® were essential in obtaining the required refrigerator power. Therefore, it was possible to determine the required insufflation flow rate for each environment and thus distribute the diffusers and ducts.

As a result of the internal and external thermal load acting on the structure, a value of 52 kW and a total insufflation flow of 4.35 m^3/s were found. Thus, the cooling power is 62kW, approximately 18 TR. After obtaining all parameters, the total head loss of the system was calculated, resulting in 40.62 mmCa. Finally, the refrigeration machine defined was the model 39DB18 from the Carrier company catalog, and the choice was made based on the maximum required thermal load and maximum flow of the insufflation and return diffusers, chosen respectively, in the ADQ 42 and size 7 models according to the TropicalRio company. Companies that had great versatility as well as easy maintenance were chosen. The ducts were dimensioned according to NBR 6401, obtaining the pressure loss values through the constant friction method and defining the commercial diameters for each section, according to the Refrin company catalog. All the necessary system requirements have been satisfactorily met.

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