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Hourly Cooling Load Assessment Utilizing Three Different Methods for a Full Day

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Abstract

Human beings are facing an unprecedented rise in temperature rates not recorded for years. HVAC (heating, ventilation, and air conditioning) systems have been created and enhanced to solve this issue.
Cooling load must be estimated with accepted methodologies before designing an efficient and effective air conditioning system. Companies, researchers, institutions, and others advise and develop many cooling load calculation methods. Each one of these methods has its advantages and disadvantages and may give a slightly different result for the same case. For each building, whether it was residential or commercial buildings, gyms, or shopping malls, before making the decision on (HVAC) systems to be used, both heating and cooling loads should be obtained as correctly as possible to minimize expenses as possible. Since the HVAC system consumes the most energy in an air-conditioned building, an accurate method of cooling load estimation is necessary. Consequently, an energy-efficient air conditioning system reduces greenhouse gas emissions into the atmosphere while also saving money on electricity.
Two cases have been compared and studied, one in Dubai UAE, and the other in Baghdad Iraq. Three different methods, HAP, hand calculation method (CLTD/SCL/CLF), and MS-EXCEL E20 form sheet were used to compare the accuracy of the results for cooling load.
Results of E20 and HAP are very close to each other with high accuracy for peak load, the big difference can be found between the CLTD method and the other two methods. The value of the maximum difference percentage was found between CLTD and E20 equals 3.28% and 7.96%, on the other hand, the lowest difference was equals to 0.3% and 1.51% between HAP and E20 results for Baghdad and Dubai respectively. Traditional and local materials came from local factories, used in buildings played a big effect on the results, which may not match those materials stated in the ASHRAE or CARRIER tables, which need to be considered in the results and calculation procedure. However, all methods have a percentage of difference but all results are within the accepted range and are applicable for practical cases. Of course, this percentage is minimal with some methods and maximum with others.

1. Introduction

Cooling of structures such as buildings, gyms, wedding halls, malls, and so on, currently represents an important amount of the world's gross energy usage. In Iraq, the building industry consumes around (38%) of the overall energy generated from electricity [1]. Each space requires a certain degree of conditioning to be comfortable, and obtaining that degree of comfort is entirely contingent on having the appropriate size of air conditioning equipment. Many problems might arise when the heating or cooling system does not meet the needs of your space. Some of these are uncomfortable indoor conditions, reducing the system's life cycle and overloading it, insufficient efficiency, and wasting money on electricity bills.

At present, air conditioning manufacturing is a major business sector. The most important goals are to improve air conditioning system efficiency and building energy performance.

It is known that the more accuracy followed in estimating the cooling load of the construction envelope during the year, the more energy can be conserved. Understanding which strategies provide the optimum cooling impact is critical. Comparing the outcomes of various approaches can help achieve this objective. Over the past several years, numerous techniques have been created and applied for this purpose.

ASHRAE issued five methods for computing building cooling requirements to date: the Total Equivalent Temperature Difference/Time Averaging (TETD/TA) method, the Transfer Function Method (TFM), the Cooling Load Temperature Difference/Solar Cooling Load/Cooling Load Factor (CLTD/SCL/CLF) method, the Heat Balance Method (HBM), and the Radiant Time Series Method (RTSM) [2], [3].

In 2005, Al-Badree and Joudi compared cooling load values from three distinct approaches, which are TFM, CLTD/SCL/CLF and TETD/TA methods and experimental readings. The study case was a single room in Baqubah northeast of Baghdad. The air conditioner employed was a window-mounted unit having a capacity of 2 T.R.

The comparison showed a big difference between calculated and measured values. The difference ranged from 33% to 40%. This large difference appeared due to several reasons but the most important one is that the construction

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