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A Review on Coefficient of Performance of HVAC Framework

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***Abstract*: This study provides the CLF/CLTD technique, which demonstrates the scope and potential of evaporative cooling systems for partially or fully replacing high power using air conditioners to preserve thermal comfort in diverse climatic regions without sacrificing the indoor air quantity. This research applied the technique to the city of Kanpur, which is characterized by varying climatic conditions throughout the year. This article's calculation technique investigates the feasibility of space conditioning the interiors of an Indoor Skate park building at NCET Engineering Collage, Kanpur, utilizing evaporative cooling throughout the summer months of April and May. The calculation technique for cooling loads owing to solar radiation transmitted through fenestration was modified to include a new factor, the solar cooling load (SCL), which is more precise and simple to use.**

***Keywords*: CLF/CLTD method, evaporative cooling, air conditioning.**

1. Introduction

The process of adiabatic saturation results in evaporative cooling. It is a process that involves the removal of sensible heat from air and the addition of latent heat in the form of additional water vapor.

This form of cooling is often utilized when the outside circumstances are extremely dry, resulting in a huge wet bulb depression of air.

In a dry area, evaporative cooling can provide some comfort by eliminating the room's perceptible heat. In comparison to the vapor compression system, the evaporation cooling system requires a considerable amount of air to fulfill the room's sensible heat load since the temperature differential between the room and the supply air is generated. In case of evaporative cooling the ACH of the order of 20 change in air, the amount of air supply may therefore be in the range of 8-10 air changes per hour (ATC), since the humidity of air washes drops fast. Since the publication of ASHRAE's Cooling and Heating Load Calculator Manual (ASHRAE 2011), originally developed as a manual calculation process, some approximations that led to the significant accuracy under certain conditions were used, since cooling load difference cooling load (CLTD/CLF) method was a popular method for calculation of cooling loads. The handbook shows certain restrictions on the use of the elements in the ASHRAE Manual of Fundamentals for the CLTD/CLF approach. The study showed that factors not included in the original paper might influence outcomes substantially.

2. Cooling Load Calculation Method

The choice of system components and equipment for heating, ventilation and air conditioning (HVAC) should always depend on the exact assessment of the heating and cooling loads of the building. The cooling charges in a single area in the ground level of a single floor assembly hall are evaluated during this present study. The aim of this work is for the estimation of building cooling demands to be introduced using, ASHRAE has been developing a streamlined hand calculation technique for the cooling charge temperature difference/solar load/cooling load factor (CLTD/SCL/CLF) load estimate approach.

This is the most frequent approach for simple instructions on calculating cooling loads because of its simplicity. The space coolers are the frequency at which the temperature and relative humidity of the space are reduced to maintain the ideal conditions in space. There are numerous components to the cooling load for a room, including:

- Heat gain via the roof, external walls, above lighting and windows from outside the roof. (This covers the impacts on the outside surfaces of the sun.)
- Solar heat recovery through skylights and windows.
- Driving heat gain through the ceiling, internal partition walls and floor from adjacent areas.
- Internal increases in heat from people, lighting, equipment and space equipment.
- Hitting the air through doors and windows, and minor splits within the building envelope infiltrate into the space from outside.
- Heat gain purposefully transferred for ventilation purposes owing to outside air entering the building.
- heat produced by the systems fans and perhaps other system heat gains.

The cooling coil in the HVAC system also has to manage the

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entire building cooling load, including: Other components of:

The place is supposed to be free of plenary (the space between the ceiling and roof). The whole heat gain from the roof and the illumination therefore immediately impacts the area.

3. Cooling Load Component

Components for cooling load: These loads add sensitive or latent heat to the area. The roof, external walls, windows, skylights, ceiling, internal walls, and floors, and sunlight via windows and skyscrapers contribute solely to sensitive heat in space.

The individuals in the room bring sensitive and latent heat. Lighting provides just sensitive heat to the space, whereas space equipment can only produce sensitive heat (like for the computer) (as is the halogen lamp). Infiltration usually provides sensitive and latent heat for the environment.

Additional ventilation and system heat gains have to be handled by the cooling body. Ventilation adds to the coil load through both sensitive and latent heat. Other heat gains in the HVAC system (for instance from the fan) only add sensitive heat.

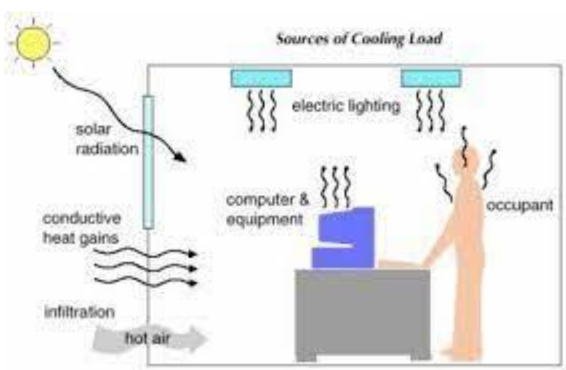

Fig. 1. Load Components

4. Heating Load vs. Cooling Load Calculations

As the name indicates, heating load calculations are made to predict the building's heat loss in winter so that the necessary heating capacity can be achieved. The peak heated charge normally occurs during the winter months before daybreak and the circumstances outside during the winter season do not greatly alter. Furthermore, interior heat sources, such as inhabitants or equipment, compensate for some thermal loss. The computation of heat stress is typically performed if stable circumstances are met (no sun radiation and constant temperatures outside) and heat resources are neglected.

It's a basic, yet cautious technique that results to a modest heating surplus. The thermal capacity of walls and interior heat sources, which complicates the situation, have to be taken into consideration for a more precise estimate of heating loads.

To estimate cooling loads, the state processes are instable since the peak cooling demand occurs during the day and because of the solar radiation external circumstances also change considerably during the day. Furthermore, all internal sources contribute and ignore the cooling loads lead to underestimations of the necessary cooling capacity and the risk that the requisite interior conditions are not maintainable. Thus, the intrinsically more difficult cooling calculations are.

The credit for solar heating gains or internal heat gains is often not included in the determination of heat load, and the thermal saving effects of the construction in general are not taken into account. While the thermal storage qualities of the structure play an important part when calculating the cooling load, as when heat starts to flow, the time that the space can recognise that the heat gain is substantially neutralised as a cooling burden.

A. Space Heat Gain

This instantaneous heat gain rate is the rate at which heat enters and/or is created in a given moment in a particular space. Classification of heat gain is:

- Sun radiation via transparent surfaces like windows
- Drive heat via the outside walls and towers.
- Drive heat via internal scatters, ceilings and floors;
- The inhabitant, lighting, equipment, operations create heat inside the area
- Loading due to ventilation and external air penetration
- Other diverse heat gains

B. Sensible Heat

The heat that a substance absorbs and the temperature increases does not affect the condition of the substance. Through the conduction, convection and/or radiation sensitive heat gain is added to the conditioned area. Note that due to the heat stored in a building envelope, the sensitive heat gain in the conditioned area did not correspond to the sensitive cooling charge at a time interval. The only cooling charge is the convective heat.

- Heat transferred via floors, ceilings, walls Sensitive heat load.
- Body heat of the occupant
- Heating of equipment & light
- Gain solar heat from glass.
- External air infiltration
- Ventilation air

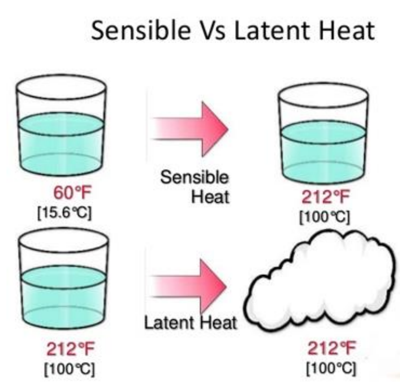

Fig. 2. Comparison of Heat within Space

C. Latent Heat Loads

When humidity is supplied to space from internal (e.g. vapor released by inhabitants and equipment), as a consequence of infiltration or ventilation, latent heat gains are generated in order to maintain a correct indoor air quality. Latent thermal load is

- Off-air humidity-loaded infiltration & ventilation
- Breathing and Activities Occupant
- Equipment and devices moisture

The water vapors must condense on a cooling unit at a rate equal to the rate of their addition to the area to maintain a constant moisture ratio. For instance, 1 kilograms of moisture removal takes roughly 0.7 kWh of energy and is extremely energy-intensive.

5. Components of Cooling Load

The overall load includes heat transported via the envelope of the building (walls, ceiling, floors, windows, doors etc.) and heat generated by the inhabitants, equipment and lighting. The load is considered an exterior load due to heat transmission via the envelope, whereas all other loads are called internal loads. The exterior compared to interior load varies by kind of structure, the weather and the architecture of the building. In every building the overall cooling load includes both sensitive and latent load components. The sensitive charge influences the temperature of the dry bulb whereas the latent charge changes the moisture content of the spacing.

Construction can be categorized as externally loaded and loaded inside. The cooling load on the building is mostly caused by the heat transmission between the outside and inside conditioned space in externally laden buildings. Given that circumstances vary substantially on every day the cooling load of a structure which is loaded externally fluctuates widely. The cooling charge is largely due to internal heat generation sources such as people, lighting or appliances in internal charged structures. In general, it is possible that internal heat sources cause the heat generation to stay very continuous and that the heat transfer from the changing environment is significantly less than internal heat sources. Of course the system design approach for an externally loaded structure from the economic and energy efficiency points of view.

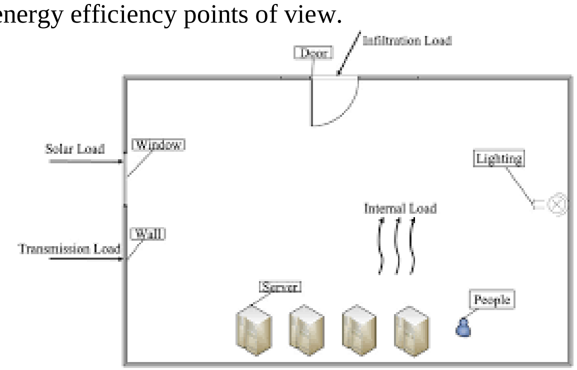

Fig. 3. Cooling Load Components

6. Literature Survey

We have examined and referenced to the following research papers/journals:

- M. M. Kulkarni et.al researched that using 2010 Pune City surface data, it has been investigated to use the feasibility of the evaporative refrigeration system to provide human comfort using the FI method. The evaporative cooling system can be recommended in Pune regions for 7 to 8 months per year if its temperature is below 24 C. DIDIC system achieve the largest decrease in temperature, whereas IDEC system achieves the lowest drop in temperature. Taking into account energy efficiency, air temperature, humidity and practicality, one out of four systems presented is more effective and recommended. The EAS systems have a tremendous potential for eight months a year to replace traditional climate control systems in total or in part for Pune City, which provides significant power savings.
- Krishankant et.al said that in April and May in Delhi an evaporative chiller provides Indore with thermal comfort. A wide comfort zone proposed by Watt is possible in June with air conditions in the room.
- This means that the inconvenience will be significantly reduced. Furthermore, the circumstances inside the pleasant range on a thermal sensation scale created by Sharma and Ali [6], which is relevant to tropical summer. Here you can utilise a 20-40 percent BFF cooler and a suitable 40W air rate up to 40 a.m. Air exchange rate of 5 h in April, 10 h in May, 40 h in June should 5 be applied for a room with an uncovered roof and the heat loads evaluated in this study.
- C. S. Datta et al in this analysis, it is apparent that the potential energy savings for traditional cooled systems to be replaced with evaporative systems are 75%. In climates where wet bulb temperatures are generally < 25 °C, indirect systems can attain equivalent comfort levels as cooled systems. [7]
- Khalid J et. al has shown that, for most durations of system operation in many places, indirect evaporative cooling would lead to a pleasant interior state. Furthermore, the findings reveal that the performance coefficient is quite high, since the system uses fan and water pumping power only. [8]
- J. K. Jain, et. al has shown The study of two novel cooling evaporative pad materials was conducted. Normally, aspen and khus fibres are used for evaporative refrigeration. The pad containing Palash fibres was 13.2% and 26.31% more effective than aspen and khus pads, respectively. At 8,15 percent greater than that of khus, the efficiency of coconut fibre was found to be equivalent to that of aspen pads. The Khus pad gives the lowest pressure decrease, but it offers the largest pressure decrease (most often used) among the four test materials [9].
- Obuka et.al in Visual Basic, this work creates the computer application that can calculate the sensitive and latent cooling charges of a single area of non-residential buildings using the CLTD/SCL/CLF technique. The programme created is improved to make it more user-friendly via a unique Graphical User Interface (GUI). These are primary assumptions given by ASHRAE to calculate the heat gain and refrigerant load. The basic

equations about the problem have been supplied.

- Kulkarni and others; Together with a wet platform heat exchanger indirect phase type and various forms and cooling medium, two stage direct evaporative coolers are manufactured and tested in a direct phase. The direct phase of cooling pads consisting of rectangular, semi-cylinder and semi-hexagonal wooden pads, hard cellulose and aspen fibre. The performance was evaluated for continuous secondary airflow of about 1 kg/ s in direct cooling mode and combination cooling mode. Primary airflow varied from 0.078 to 1.011 kg/s. Temperature of the average dry bulb inlet ranged from 39^0 to 43^0C and relative humidity was 37 to 46 percent.
- Spilter.et al Album A comprehensive overhaul of the cooling load difference/coolant load factor (CLTD/CLF) approach is described in this article. The key changes to the original CLTD/CLF procedure are as follows: 1. By introducing a new, more accurate and easier to use solar cooling load (SCL) factor, the calculation process for cooling loads conveyed by solar radiation via fenestration was reviewed [1]. In the past, solar radiation cooling loads conveyed via fenestration were relatively incorrect when a combination of latitude~months different than 40°N/July 21 was employed. [2].
- Ansari et. al. The current paper shows how some easy issues are made, because of academic or commercial compulsions, mathematically complicated and somewhat tiresome. After several simplifying assumptions, there are several issues where the mathematical model is constructed. However, highly advanced and complicated techniques are used while solving these models. Dual policies are meaningless for such issues, and in many situations the problem may be addressed more easily to achieve same precision.

One such case is given in this publication. It deals with computer software development and authentication to estimate construction cooling demand. The programme is easier to use, requires less input data and is more adaptable than any other commercially available software, which is quite pricey and widely utilised. Effects such as orientation, type of glass shade, numbers of glass panes used, insulation of walls, style of roof and type of floor, of important structural factors may be easily examined. For a common building block to reach an educated choice, the effects of these factors have been explored. It cannot be done so conveniently with any other programme or way. All the above mentioned advantages are without sacrificing accuracy and reliability.

7. Conclusion

The CLTD/CLF process is the easiest and most simple way to resolve the problem of calculating the cooling load estimate of the CLF/CLTD method assembly for forecasting the poor cooling owing to heat gain from walls and roofs. The ASHRAE Basics Handbook (2011) provides the CLF/CLTD technique, which allows a transfer functional coefficient for any appropriate wall or roof design, simplifying the selection process of a wall or roof type and guaranteeing the correctness of the transmission. For calculation of all zones, the CLTDs are utilised. By introducing the tabular values for solar coolers, the calculation of cooling load owing to transmitted solar radiation and absorbed fenestration was reviewed (SCL).

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